OBJECT LESSONS
FOR
RURAL SCHOOLS

BOOK I

VINCENT T. MURCHÉ

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OBJECT LESSONS FOR RURAL SCHOOLS

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THE TEACHER'S MANUAL

OF

OBJECT LESSONS

FOR

RURAL SCHOOLS.

BY

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LESSONS IN ELEMENTARY SCIENCE AND GEOGRAPHY COMBINED,'
'SCIENCE READERS,' 'DOMESTIC SCIENCE READERS,'
'COMBINED READERS IN ELEMENTARY SCIENCE
AND GEOGRAPHY,' 'RURAL
READERS,' ETC.

BOOK I

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PREFACE

THESE Manuals and the Reading Books which accompany them have been prepared as the outcome of the "**Circular to Managers and Teachers of Rural Elementary Schools,**" which was issued by the Board of Education in April last.

The Author, **himself an old rural teacher,** has endeavoured to cover as much ground as possible in meeting the requirements of that Circular, and of the schemes set forth in the Revised Instructions to H.M. Inspectors. But it should be distinctly borne in mind that **these books are not intended to form a rigid cast-iron scheme of lessons,** to be blindly followed by every teacher into whose hands they may fall. They are rather to be considered as **a store-house from which the teacher may draw,** to suit his own special conditions; and, further, the ample provision of subjects in each volume will enable him for years to construct scheme after scheme, all of them dealing with **just those subjects which will appeal to country children.**

The great aim of the teaching throughout has been to awaken in the children **the spirit and habit of observation and inquiry,** and thus to foster in them the **love of country life,** and the only true way to do this is to follow the excellent and wise recommendation of the Circular referred to above, in taking them for rambles wherever possible, and giving them lessons on the spot, which can be afterwards recapitulated, amplified, and illustrated in school by means of pictures, drawings, and specimens.

It is only those who know what it means to carry on a country school (if not single handed, at least with inadequate assistance) who can really sympathise with the rural teacher and his work. This the Author can fully claim to do, and in consequence the scheme has been arranged to meet as nearly as possible the conditions of the average village school.

All reference to standards has been carefully avoided, and the lessons have been arranged to suit the usual tripartite division of the school as recommended in the schemes of the Government Circular. It is confidently expected that, with the wealth of natural objects for illustration always ready to hand, the course will prove attractive both to teachers and children.

Notwithstanding the fact that the books have been written primarily to provide for the wants of the Rural School, it must not be forgotten that there are hundreds of provincial towns in all parts of the country, where the everyday life of young and old is more or less surrounded by rural pursuits, where living in the town they breathe the atmosphere of the country, where every walk takes them into the heart of the country, and where the villagers from all round come and go regularly on market-days.

In all such towns it is thought that this scheme may find hearty appreciation.

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THE CURRICULUM OF THE RURAL SCHOOL

THE following circular to managers and teachers of rural elementary schools has been issued by the Board of Education :—

BOARD OF EDUCATION, WHITEHALL,
LONDON, S.W., *April* 1900.

SIR—The Board of Education are anxious to call the attention of managers and teachers of elementary schools situated in the agricultural districts of England and Wales to the importance of making the education in the village school more consonant with the environment of the scholars than is now usually the case, and especially of encouraging the children to gain an intelligent knowledge of the common things that surround them in the country. From experience gained in various districts it is found that by a suitable arrangement and handling of the school curriculum this object can often be attained without necessarily adding any new subjects to the time-table, or demanding any undue burden or work from teachers or scholars.

The Board would deprecate the idea of giving in rural elementary schools any professional training in practical agriculture, but they think that teachers should lose no opportunity of giving their scholars **an intelligent knowledge of the surroundings of ordinary rural life** and of showing them how to **observe the processes of nature** for themselves. One of the main objects of the teacher should be to develop in every boy and girl that **habit of inquiry and research** so natural to children; they should be encouraged to ask their own questions about the **simple phenomena of nature** which they see around them, and themselves to **search for flowers, plants, insects,** and other objects to illustrate the lessons which they have learnt with their teacher.

The Board consider it, moreover, highly desirable that the natural activities of children should be turned to useful account—that **their eyes,** for example, **should be trained to recognise plants and insects** that are **useful** or **injurious** (as the case may be) **to the agriculturist,** that **their hands should be trained to some of the practical dexterities of rural life,** and not merely to the use of pen and pencil, and that they should be taught, when circumstances permit, how to **handle the simpler tools that are used in the garden** or on the farm, before their school life is over.

The Board are of opinion that one valuable means of evoking interest in country life is to select for the object lessons of the lower standards subjects that have a connection with the daily surroundings of the children, and that these lessons should lay the foundation of a somewhat more comprehensive teaching of a similar kind in the upper standards.[1] But these object lessons must not be, as is too often the case, mere repetitions of descriptions from text-books, nor a mechanical interchange of set questions and answers between teacher and class. To be of any real use in stimulating the intelligence, the object lessons should be the practising-ground for observation and inference, and **they should be constantly illustrated by simple experiments and practical work in which the children can take part, and which they can repeat for themselves at home with their own hands.** Specimens of such courses can be obtained on application to the Board of Education. These may be varied indefinitely to suit the needs of particular districts. They are meant to be typical and suggestive, and teachers, it is hoped, will frame others at their discretion. Further, these lessons are enhanced in value if they are connected with other subjects of study. The object lesson, for example, and the drawing lesson may often be associated together, and the children should be taught to draw actual objects of graduated difficulty, and not merely to work from copies. In this way they will gain a much more real knowledge of common implements, fruits, leaves, and insects than if these had been merely described by the teacher or read about in a lesson-book. Composition exercises may also be given—after the practical experiments and observations have been made—for the purpose of training the children to express in words both what they have seen and the inferences which they draw from what they have seen; and the children should be frequently required and helped to describe in their exercise books sights of familiar occurrence in the woods and in the fields. Problems in arithmetic connected with rural life may also be frequently set with advantage.

The Board of Education also attach considerable importance to work being done by the elder scholars outside the school walls, whether such work takes the form of elementary mensuration, **of making sketch plans of the playground and the district surrounding the school,** of **drawing common objects,** of **paying visits of observation to woods, lanes, ponds, farms, and other suitable places under the guidance of the teacher,** or **of the cultivation of a school garden.**

The teacher should as occasion offers take the children out of doors **for school walks at the various seasons of the year,** and **give simple lessons on the spot** about **animals in the fields and farm-yards,** about **ploughing and sowing,** about **fruit trees and forest** trees, about **birds, insects, and flowers**, and **other objects of interest.** The lessons thus learnt out of doors can be afterwards carried forward in the schoolroom by reading, composition, pictures, and drawing.

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[1] The important points to be observed in all object teaching were set out in the Official Circular (No. 369) issued on this subject on 25th June 1895, copies of which may be obtained from the Board of Education.

In this way, and in various other ways that teachers will discover for themselves, children who are brought up in village schools will learn to understand what they see about them, and to take an intelligent interest in the various processes of nature. This sort of teaching will, it is hoped, directly tend to foster in the children a genuine love for the country and for country pursuits.

It is confidently expected that the child's intelligence will be so quickened by the kind of training that is here suggested, that he will be able to master, with far greater ease than before, the ordinary subjects of the school curriculum.

The Board would further urge upon any teachers now in rural schools who happen themselves to be of urban upbringing, or to have been trained in urban centres, to seize every opportunity of gaining a closer insight into the special conditions and problems of rural life, and they trust that those whose previous education has not enabled them to obtain full knowledge of the main principles and phenomena of rural life and activities will be able to attend such holiday courses and classes as may be placed within their reach for this purpose by county councils or other local committees; since it is only when the teacher is genuinely interested in and well informed about the occupations of country life that any such results can be looked for in the children as have been referred to as the proper object of rural schools in the present circular.

I have the honour to be, Sir, your obedient servant,

G. W. KEKEWICH.

EDUCATION DEPARTMENT. Circular **369.**

Circular to H.M. Inspectors.

Object Teaching.

EDUCATION DEPARTMENT, WHITEHALL,
LONDON, 25*th June* 1895.

SIR—It has been observed that in Schools in which Object Teaching has been introduced with most success the teachers have carefully distinguished between two kinds of instruction which in other schools are not seldom confused. These two kinds of instruction are—(1) observation of the Object itself, and (2) giving information about the Object. This distinction is of importance, because the scope and method of the lesson differ according to its nature. Object teaching leads the scholar to acquire knowledge by observation and experiment; and **no instruction is properly so-called unless an Object is presented to the learner so that the addition to his knowledge may be made through the senses.**

Junior teachers have not unfrequently given lessons before H.M. Inspectors, which were wrongly described as Object Lessons, because in dealing with the topic selected no suitable appeal was made to the eye of the scholar.

The following suggestions, which have been made by practical teachers, will be found useful:—

The teacher should select only so many of the Objects set forth in the appended or other similar lists as can be dealt with in the year, without overburdening the scholars. Habits of observation are better cultivated by the thorough examination of a few objects than by the superficial treatment of many.

No object should be chosen which the teacher cannot thoroughly illustrate either by the object itself or by some adequate representation of the object, or by both. All that is purely technical, whether in the mode of study or the language and terminology, should be carefully avoided.

The children should be encouraged to bring with them to the lesson illustrative specimens which they have collected or borrowed from friends.

The children should be encouraged to make simple drawings illustrative of their observations, wherever possible, and in certain cases to make simple records on square-ruled paper. Clay modelling and other manual occupations may be employed to test the accuracy of the impressions which the children form, and to fix them in their minds. Teachers also should frequently illustrate details of the lesson by blackboard drawings. Children who are jaded in five minutes by a lecture will be open-eyed and receptive for half an hour while the teacher draws as well as talks.

The attempt to teach children to be accurate in observation cannot be separated from the need of making them accurate in description. After the children have been trained to observe a fact they should be practised in making a correct statement of it in a sentence of their own. This oral answering in complete sentences will lead to correct use of the English language, both in talking and writing, and will store the mind with a useful vocabulary. In the higher standards the children will be able to write brief weekly compositions in which they may express in a written form the ideas which they have acquired through oral instruction.

To sum up the main value of Object Teaching, there are three principal uses. The first and most important is to teach the children to observe, compare, and contrast; the second is to impart information; and the third is to reinforce the other two by making the results of them the basis for instruction in Language, Drawing, Number, Modelling, and other Handwork.

There are, however, other important uses of good Object Teaching. It makes the lives of the children more happy and interesting by opening up an easily accessible and attractive field for the exercise of brain, hand, and eye. It gives the children an opportunity of learning the simplest natural facts, and directs their attention to external Objects, making their education less bookish. It further develops a love of nature and an interest in living things, and corrects the tendency which exists in many children to destructiveness and thoughtless unkindness to animals, and shows the ignorance and cruelty of such conduct. The value of the services which many animals render to man should be dwelt upon, and the importance of kindly treating them and preserving them should be pointed out. By these means, and in other ways, good Object Teaching may lay the foundation for the right direction of the activity and intelligence of the children throughout the whole school.

I have the honour to be, Sir, your obedient servant,

G. W. KEKEWICH.

EXTRACTS from the REVISED INSTRUCTIONS issued to H.M. INSPECTORS, and applicable to the CODE of 1900.

Object Lessons for Country Schools.

The farmyard. Its buildings and their contents. Animals kept on a farm and their uses. Necessity of cleanliness, kindness, and suitable food.

The dairy and its contents. Butter- and cheese-making.

Bees. Bee-keeping.

Spring. Spring flowers. Work in the fields in spring. The cuckoo and swallow. Record date of arrival.

Summer. Different kinds of leaves and fruit. Work in the fields in summer.

Autumn. Work in the fields.

A mill and the work of a miller.

Winter. Frost. Ice. Snow.

Birds. Singing birds, as the thrush and nightingale. Birds of prey, as the hawk. Swimming and wading birds, as the duck and heron.

Wild Animals. The fox, hare, and rabbit.

Minerals. A mine. Three useful minerals.

The lessons on the seasons should correspond with the actual seasons of the year, and the different operations explained should be taken while each is in progress.

Leaves of trees may be dried by simply placing them between sheets of paper and pressing them. Their shapes may be used for the children to draw round on paper, which can afterwards be pricked and then sewn round.

Springtime. { The waking of Nature.
The lengthening daylight in the morning and evening, the coming warm weather, birds singing, building their nests, laying their eggs, the trees and hedges changing, buds and leaves, the bloom on fruit trees. }

The local wild flowers of spring. The daisy, primrose, bluebell.

Summertime.

The local wild flowers of summer.

Autumn.
The local wild flowers of autumn.
Winter. The repose of Nature.
The land. Woodland, meadowland, ploughland, moorland.
The sky.
A bird—covering, wings, beak, feet ; motion : nests, eggs, food.

Local birds.
  Thrush or blackbird.
  Lark.
  Robin.
  Rooks.

Birds which come for the summer.
Birds which come for the winter.

Local wild animals.
  Rabbit.
  Hare.
  Fox.
  Hedgehog.

Animals on a farm.
Our village.
The carrier's cart.
The cottage garden.
The stream or river, its banks, the birds and animals that live near it.
A fish.
A plant.
The garden in spring.
The farm in spring.
The garden in summer.
The farm in summer.
The garden in autumn.
The farm in autumn.
The garden in winter.
The farm in winter.
The weather and wind.
The soil ; sunshine, air, rain, frost, manure.
The farmer's tools. The plough, drill, reaping-machine.
The crops ; grass, corn, root-crops.
Wheat.
The potato.
The oak tree.
The elm tree.
The apple tree.
Evergreen trees.
An insect.
The spider and his web.
The butterfly ; colours, beauty, history.
Bees.
The farmer's pests.
The farmer's friends.
A pond.
A frog.

A ramble in a wood and what may be seen there.
The railway.
Market-day in the neighbouring town.
A newspaper.

EXTRACTS from other LISTS in the same "INSTRUCTIONS," suggestive of COUNTRY LIFE.

Plant Life.

The study of plants as growing things.

Grow an onion in a bottle of water and note appearance of root and stem. Make a model in clay of the various stages of growth at short intervals.

Grow mustard seed on damp flannel and note stages of growth.

Notice a few curious roots.
  The carrot. Cut off the top of one and grow it in a saucer of water. Contrast the root of a daisy (fibrous).
  Roots which walk. Strawberry or strayberry.
  Violet root.
  Contrast root of Iris and Solomon's Seal in their modes of extension.

Stem. Count the rings in a trunk that has been felled. Rings, how produced; estimate age of tree; the record of wet or dry seasons.

Climbing stems. Ivy.
  Train bindweed up a stick and note that it turns to the right. You unwind it and force it the other way (to the left), note how it resumes its old direction again, holding the stick with one of its leaf stalks to get a purchase for the change.

Simple experiments to show effect of light on (1) leaves and (2) roots. Celery; blanching.

Leaves of deciduous trees contrasted with leaves of evergreens. Contrast leaves of holly, ivy, and box with leaves of oak, elm, and beech.

Note autumn tints. Collect and press leaves of various colours in autumn.

Buds. Leaf buds and flower buds.
Parts of a flower. Flowers of curious shape. Pea blossom.
Fruits. Different kinds.
Insects and flowers. Colours of flowers.
Riverside plants.
Plants that grow in running water.
Plants that grow in still water.

Meadow and pasture plants. Turf on the downs, hay in the valleys.

Plants of the heath and moor.
Plants of the hills and woods.
Hedgerow trees—elms and ashes.

Trees of the forest—oak, beech, birch.

Evergreen trees—pines and firs.

Evergreen plants and shrubs—holly, ivy, box. Contrast evergreen and deciduous leaves.

Riverside trees—willows, poplars, aspens.

Animal Life.

The Cat (compare with Dog).—Eyes, rough dry tongue, soft pads and sharp claws, teeth, method of holding prey, drinking, covering of fur, whiskers, tail.

The Cow (compare with Sheep and Goat).—How she takes her food, teeth, chewing, milk (cheese and butter), tail, hoofs, covering, ears, horns, nose.

The Horse (compare with Donkey).—Covering, teeth, hoofs, tail, mane.

The Rabbit (compare with Hare).—Teeth, legs, feet, claws, covering, tail, whiskers, ears, eyes.

The Mouse (compare with Rat and Water Rat).—Teeth, paws, tail, whiskers, eyes, ears.

A Fish.—How fitted to live in water, weight, shape, covering, temperature, movements.

Animals which sleep in winter.—Examples: squirrel, dormouse, common snake, frog, toad, snail, slug. Preparation made for sleep.

Mole.—Shape, snout, teeth, paws, claws, eyes, ears, fur, food.

Hedgehog.—Covering of spines, how it rolls itself into a ball and why, head, teeth, food.

Common Snake (compare with Viper).—Shape, covering, teeth, how it moves, how it swallows its prey.

Frog (compare with Toad and Newt).—Movement, capture of prey, breathing, winter quarters.

Garden Snail (compare with Slug).—Shell, mantle, head, horns, eyes, food, preparation for winter sleep.

Earthworm.—Shape, rings, locomotion, food, usefulness.

Spider (contrast with Bee).—Shape, segments, legs, eyes, jaws, spinnerets, web, breathing organs.

Paws and Claws and their uses.—Cat, dog, rabbit, mouse, mole, frog.

Tails and their uses.—Horse, cow, donkey, dog, cat, monkeys, harvest mouse.

Tongues and their uses.—Cat, dog, cow, woodpecker, frog.

Teeth and their uses.—Man, cat, cow, horse, rabbit, snake, fangs of poisonous snakes.

Hair, Fur, Wool, and their uses.—Cat, mole, dog, sheep, fox.

Beaks of Birds and their uses.—Duck, fowl, parrot, sparrow, goat-sucker, heron.

Feet of Birds and their uses.—Duck, fowl, swift, owl, etc.

Insects.—Examples: Bee, beetle, butterfly, cockroach, silkworm. Insect development, legs, wings, segments, mouth, breathing apparatus, ovipositors.

Natural Phenomena.

The Sky.—Sunrise, noon, and sunset. (Note the object over which the sun is seen to rise from month to month. Note sun's position at noon, and its varying height above horizon.)

Shadow. (Note by aid of a spike erect on a flat disc the varying length of the shadow at noon. Study the shadows of objects. Variation in sharpness and depth.)

Moon. (Note the changes. Draw the shape from week to week.)

The Air.—Wind. Varying direction. (Note and keep record of the direction of the wind from day to day.)

Warmer and colder winds; rainy and dry winds.

Moisture in the air shown by seaweed; string (changing tension).

Wet cloth dries in the wind (water turns to vapour).

Vapour turns to water. (Breathing on slate. Clouds on hills. Evening mists.)

Clouds in the sky. Three chief kinds: "heaps," "beds," "feathers."

Rain. (Note size of drops. Raindrops on dust form little balls. Note effect of heavy rain in tearing up roads. Note the channels so made, and the arrangement of the sand and pebbles washed to a distance.)

Rainbow. (Note the succession of colours. Note position of sun behind observer and of the bow where the shower of rain is falling. Note that height of arch changes. When is it higher and when lower?)

Rainbow colours on shells, film of tar, etc. Feathers of birds.

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NORMAL HOOGHLY SCHOOL

~~No 6354~~

BOOK I

LESSONS FROM SIMPLE NATURAL PHENOMENA

Lesson I

THE AIR AROUND US

Provide the teacher with: a large basin, a can of water, a flask, some small stones, a piece of glass-tubing, one or two large sponges, a large, well corked flask fitted with an air-tight glass and india-rubber tube, with a spring clip for closing it at will, a good pair of balance, the spirit-lamp, a sand bath, a fan, a pair of bellows, a few feathers, little pieces of paper and other light things to lay on the table, and a toy boat.

I. AIR TAKES UP ROOM

1. *FILL a glass flask up to the brim with water; and then call upon the children to notice what happens if we try to pour more water into it.*

Drop a few stones into the flask, and point out that the same thing happens. **The water overflows in each case.**

Why is this? The water takes up all the room inside the flask. There is no room for anything else, because the flask is full of water. **Some of it must flow out to make room for the stones.**

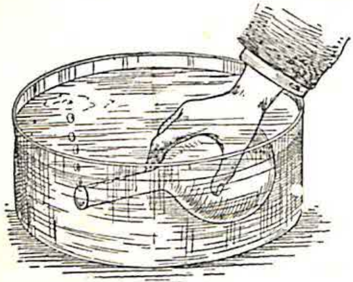
2. Now I will pour all the water and the stones out again, and you will perhaps tell me that the flask is empty, for we cannot see anything in it. Let us find out whether it is really empty.

Plunge the flask, mouth downwards, in a vessel of water, and then call attention to the water inside the neck of the flask. **It is not on a level with that all round it.**

It rises only a little way up the neck. **We cannot force the water up into the flask itself.**

Why can't we make the water go up into the flask? I will show you.

3. *Slant the flask on one side, and call attention to the* **sudden gurgling sound** *that follows. Notice too* **the bubbles** *that rise up through the water.*



Something is passing out of the flask, and **as this something passes out,** the water rushes in. The flask is now full of water.

What is this something that came bubbling up out of the flask? It is **air.**

We cannot see the air, but the flask, which you said was empty, **was really full of air**—so full that **there was no room for the water to get in.** It was the air from the flask that **made those bubbles** when we slanted it.

4. *Repeat the experiment with a piece of glass tube, closing one end with the finger or thumb, and plunging the open end into the water. Show that the same thing happens again. The water will not rise in the tube* **because the tube is full of air.** *Slant it to* **let the air-bubbles escape** *as before, and then show that the water at once rises in the tube.*

Now plunge the tube in again without closing the top. This time the water inside the tube stands at the same level as that all round it.

Why? Because, as the water enters the tube below, **it drives the air out at the top** to make room for it.

5. *Show the sponge. Lead the children to notice that it is "full of holes." Explain that these* **holes in the sponge** *are called* "**pores,**" *and that the sponge is said to be* **porous,** *because it is* **full of pores, or holes.**

Place the sponge now in a saucer of water, and let the children observe that it sucks up all the water into its pores.

Squeeze it, and show how the water is forced out again.

Now take a dry sponge, and force it down below the surface of the water in the basin, calling upon the children to observe carefully what takes place.

6. *They see* **bubbles rising up through the water.** *Elicit from what they have already learned that :—*

(*a*) **These bubbles are caused by air.**

(*b*) **This air must have come out of the sponge.**

(*c*) **The water forced the air out** *of the pores of the sponge* **to make room for itself.**

Sum up what has been done by impressing upon the children that :—

(*a*) *Not only is there air in the pores of the dry sponge and in the "empty" flask, but that* **there is air everywhere.**

(*b*) **This air,** *although we cannot see it,* **is as much a real thing** *as water, stones, and other things we see around us.*

(*c*) **Air,** *like all other things,* **takes up room.**

II. AIR HAS WEIGHT

1. *Let one of the children hold a basin in his hand while it is filled with water, and call upon him to tell what he observes.*

The basin **feels heavier** than it did before the water was poured into it.

What do we learn from that? We learn that **the water weighs something.**

Show that it would be the same if we filled the basin with stones, sand, or anything else, for **all these things weigh something.**

2. *Now produce the air-tight flask. Remind the children that, although the flask looks empty, it is not really empty*—**it is full of air.** *All the room inside the flask is filled with air.*

Weigh the flask, and carefully note down its weight on the blackboard.

Then proceed to remove some of the air, either by sucking it through the tube, or by heating the flask over the spirit-lamp.

N.B.—*The flask should be stood in a sand bath over the flame to save it from flying.*

This done, close the tube by means of the spring clip, and when the flask is cool weigh it again. **It weighs less now.**[1]

Why is this? Because **some of the air has been taken out.**

What does that tell us? It tells us that **air,** like water and other things, **weighs something.**

III. Air can be Felt

1. *Set one of the children to move his hand about in the water. He can feel the water as well as see it.*

Now let them all wave their hands to and fro in front of them, and lead them to tell that they **can now feel something,** *which they could not feel while they sat still.*

Explain that this **something which they can feel is air**; *that there is air all round us, although* **we do not feel it till we make it move.**

2. *Give one of the children a fan, and let him wave it to and fro in front of the rest. All will feel the air plainly enough now.*

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[1] *N.B.*—A cubic foot of air weighs about one ounce.

Blow the bellows against their hands.

Air, then, like water, is something **which can be felt;** but we do not feel it till we set it moving, as we did with the **fan,** the **bellows,** and **our hands.**

3. How do we know that the air really moves?

Wave the fan to and fro again near the table, so as to make the feathers, pieces of paper, and other light things that are lying on it, fly about.

The fan moves the air; the air moves the pieces of paper and other things.

Put the toy boat into the water, and send it along by blowing with the bellows against its sail.

The **bellows moves the air;** it is **the moving air** that **moves the boat along**

When the air moves **it makes a wind.**

IV. WE BREATHE AIR

1. *Instruct each of the children to place one hand on his est, and take a long, deep breath, following the example of ine teacher.*

Repeat the process two or three times, so that all may note carefully what happens, and then call upon them to explain—

What are we doing now? We are **taking in air.**

Where does the air come from? It is **all round us** everywhere.

How do we know we are taking it in? **We can feel it** rush in at our mouth and nostrils. We can feel our chest heave **as it gets full of air.**

What are we doing now? We are **sending the air out again.**

2. *Explain that this is what we call* **breathing.** *We could not live many minutes without breathing. We must be* **constantly taking in fresh air,** *and giving it out again after we have used it. We breathe in this way* **even when we are asleep.** *If we could not get air to breathe,* **we should choke or suffocate.**

Tell that the air we take in at our mouth and nostrils **passes down into the lungs.** *Show the position of the lungs, and tell that* **cows, pigs, horses,** *and* **birds have lungs like ours,** *and breathe air just as we do.*

SUMMARY OF THE LESSON

1. There is air everywhere although we cannot see it.
2. Air is a real thing and takes up room.
3. Air, like every other thing, has weight.
4. Air can be felt when it is moving about.
5. When air moves it makes a wind, and causes other things to move.
6. We breathe air.

Lesson II

THE SKY

The teacher should be provided with a round glass bowl.

I. INTRODUCTION

1. *To render this lesson effective, the teacher would do well to select a bright, clear day for it, so that the children may be able*

to approach it with their minds fresh from what they have seen. Commence by leading them to talk about their run to school. How bright and cheerful everything looked. When they raised their eyes above them, they saw everywhere the clear blue sky.

To-day we are going to see what we can learn about this beautiful sky.

You saw the sky above you on your way to school; you can see it now through the window. But can other boys and girls, in other places, see the sky too? Can people a long way off see it? Yes; wherever we go, **we always have the sky over our heads.**

2. In our last lesson we spoke of something which is all round us wherever we go. What is that? Air.

This room is full of air; but when I look across it I can see things on the other side. I can see through the air, but I cannot see through this slate.

We say **the air is transparent,** because we can see through it. This slate and all other things which we cannot see through are said to be **opaque.**

Tell that **this transparent air** *is not only* **all round us** *wherever we go, but stretches high above our heads, and really* **forms the sky.**

We look up through the air around us, and see the blue sky overhead, but **this sky is only the air** itself, which spreads out and stretches upwards to a very great height.

II. SHAPE OF THE SKY

1. When you look up at the sky, what shape does it seem to be everywhere? **Curve-shape.**

Which part of the curve seems to be the highest? **The part over our heads.**

Where does the curve seem to end? It **seems to bend down** till it touches the earth on all sides.

Show a large bowl (a glass one for preference). Stand it upside down on the table, and lead the children to compare the shape of the sky to the shape of the bowl.

It looks like a very, very large bowl, placed upside down on the earth, just as this one is placed on the table. **It covers the earth** all over **like a great round roof.**

2. *Call attention to the rim of the bowl which touches the table all round.*

Lead the children to tell that when we get away from the houses and can see a long way off, **the sky seems to touch the earth,** *just as the rim of this bowl touches the table.*

Tell that this line, **where the sky seems to meet and touch the earth** *all round, is called* **the horizon.**

III. CLOUDS IN THE SKY

1. What colour do you say the sky is to-day? Blue. Is it blue all over? I think I can see some parts of it, here and there, that are not blue. Look through the window, Harry, and tell me whether you can see any parts of the sky that are not blue.

Let the child describe to the rest of the class the **small white patches** *dotted over the sky here and there. They look like little heaps of* **loose white wool** *or* **feathers.** *Elicit that these are called* **clouds.** *Point out that sometimes, although not often, there is not one of these little white clouds to be seen; the sky is blue all over. We then call it a* **cloudless sky.**

2. *Lead the children to tell, on the other hand, that they sometimes see no blue at all in the sky. It is of a* **dull grey colour** *all over.*

Explain that this is because the sky is covered with thick clouds. We then call it a **cloudy sky.**

These thick clouds **hide the blue sky** from us, because they are opaque; we cannot see through them. As soon as the clouds roll away, we see the blue sky behind them.

3. *Point out that, although the clouds sometimes shut out*

the blue sky, they are very good to us. They send us **the beautiful rain** *to make the things grow.*

Trees, grass, and flowers want rain to make them grow.

When the weather is very cold, what do the clouds send us instead of rain? **Snow and hail.**

IV. WHAT WE SEE IN THE SKY

1. *Call upon the class now to say what else they have seen in the sky besides clouds, and proceed to elicit all they have to tell about the* **sun, moon,** *and* **stars,** *assisting of course where they fail.*

THE SUN.—It shines in the daytime only. It looks **like a great round lamp** in the sky. When it is shining, **everything looks bright** and cheerful, but at night, when it is not shining, **all is darkness.**

What then does the sun do for us? It gives us **light.**

Tell that it is the light of the sun shining down upon us that gives the sky its beautiful blue colour. How **dark and cheerless** *everything would be* **without the sun.**

2. How do we feel when the sun shines upon us? We feel **warm.**

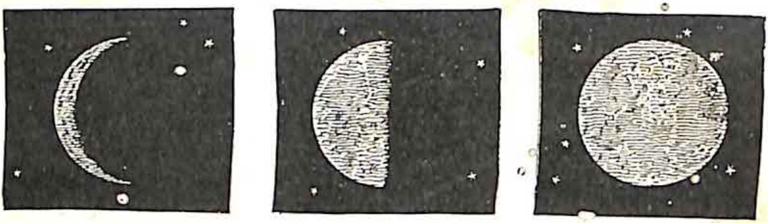
The sun then **gives us warmth as well as light.** It is **like a great round ball of fire** in the sky. Without the sun's warmth we ourselves, and all animals, would die. There would be no trees, no grass, no flowers; for they could not grow without the sun.

Sometimes the thick clouds shut out the sun, so that we can neither see it, nor feel its warmth. The sky is then dull and cheerless; there is **no brightness, no warmth** anywhere.

THE MOON.—At night, when the sun is no longer shining, the moon comes out in the sky.

1. *Lead the children to tell that it does not look like the sun—a great ball of fire. It is* **white and silvery.** *We can*

look at the moon without blinking, but we **cannot look at the bright sun.**



2. *Endeavour to make them talk of the changing shapes of the moon, and explain and illustrate on the black-board,* **new moon, half-moon,** *and* **full moon.**

THE STARS.—*Let them next talk of the stars, and when they are to be seen.*

1. How many stars are there? There are so many that **we could not count them.** They help the moon to give us light at night, when the sun is not shining on us. They are dotted **like tiny lamps** all over the sky. They shine and twinkle all night long. Sometimes **the clouds shut out the moon and stars,** and the night is then very dark.

2. *Compare the light of the stars with the brilliant light of the sun, and explain that* **all day long** *they are shining up there, just as we see them shine at night. We do not see them in the daytime,* **because their weak, pale light cannot shine through the bright light of the sun.** *But we know they are there in the daytime as well as in the night, because if we go down into a very deep dark pit, and look up at the sky in broad daylight, we can see them there.*

SUMMARY OF THE LESSON

1. The transparent air all round us reaches high above our heads and forms the sky.

2. The line where the sky seems to touch the earth is called the horizon.

3. Clouds float about in the sky. They send the rain.

4. The sun warms us and gives us light in the daytime.

5. The moon and stars give us light at night.

Lesson III

THE SUN

Brown's picture of sunrise should be shown.

I. INTRODUCTION

1. *REFER the children to their last lesson, and lead them to tell all they can of the sun, as regards its appearance in the sky, and what it does for us. It is like* **a great round ball of fire** *in the sky; it gives us* **light** *and* **warmth.** *We feel the warmth of the sun when it shines on us.*

How long does the sun shine on us? It shines on us all day. **It begins to shine** in the morning, and **it goes away** in the evening.

How do you know it is the sun that gives us light? Because in the evening, when the sun is not shining, **it grows dark,** and the next morning **it gets light again,** as soon as the sun begins to shine.

2. Can we see the sun in the sky every day, and all day long? No; we sometimes cannot see the sun at all.

Why is that? Because sometimes there are thick clouds in the sky, and **they hide the sun from us.**

But are you sure the sun is always in the sky in the daytime—say, on a very cloudy day? Yes; because if the sun was not shining, **it would be as dark as it is in the night.**

Quite right. The sun is shining in the sky **if the day is ever so cloudy.** The thick clouds hide the sun from us; but **they cannot shut out all its light.** Some of the sun's light passes through the clouds, just as it would **through our window-blinds,** if we pulled them down.

II. What the Sun is Like

1. The sun, you say, is like **a great round ball of fire.** On a bright day we cannot look at the sun. It hurts our eyes, so that we cannot see well afterwards. We say that things **dazzle our eyes,** when they are so bright that we cannot look at them without making our eyes ache.

What colour is the sun? It is not always the same colour. All day long, if the sky is clear, **the sun is bright yellow,** like gold. In the evening, just before it leaves us, **it is often red, like fire.**

2. *Remind the children of the beautiful red clouds, which are often seen in the sky in the evening. The clouds are sometimes so red, that they* **almost look as if they were on fire.**

What is it that makes the clouds look red at such times? It is **the sun shining through the clouds.**

Why is it that we sometimes do not see the sun in the daytime? The thick clouds hide it from us.

Then which must be nearer to us, the clouds or the sun? **The clouds are nearer than the sun.**

III. Sunrise, Noon, Sunset

1. We spoke about the window-blinds just now. When are we glad to pull them down? When the sun shines through the window into our eyes.

Do we pull them all down at the same time? No; sometimes one of the blinds is pulled down, sometimes another.

What do you learn from that? We learn that the sun **does not always shine through the same window.**

Ask the children to observe for themselves from day to day that in bright, sunny weather the same blind is always pulled down at the same time in the day.

The sun always shines through the same window at the same time every day, when it is not hidden by the clouds.

Lead the children in the next place to tell, from their own observation, that at a certain part of the day they always see **one side of the playground,** *or* **one side of the village street, in the sunshine;** *that later on it is* **the other side** *which is* **lighted up,** *and so on.*

2. So then the sun is **not always in the same part of the sky.** Look at the sky, and see if you can point out where it was when you went home at twelve o'clock.

Assist in this, and explain that the sun is **always in that part of the sky at twelve o'clock** *in the day. Elicit that this part of the day is called* **mid-day,** *or* **noon,** *and call upon the children to observe for themselves from time to time that the sun is* **always higher in the sky at noon** *than at any other part of the day.*

That part of the day before twelve o'clock is called the **fore-noon.** Why?

What do we call that part of the day after twelve o'clock? Why?

3. *Pass on next to think of the sun in the evening, just before it begins to get dark. Elicit that it is* **low down then,** *quite close to the earth,* **where the earth and sky seem to meet and touch.**

What do we call that part of the sky? The **horizon.**

What becomes of the sun after that? It **sinks down** below the horizon.

Explain that we then say **the sun sets,** *and lead the children to tell that the light dies away little by little, and the dark night comes on.*

4. When do we see the sun again? Early the next morning.

Picture it as it comes up gradually from below the horizon, just as we see it disappear in the evening. We then say the sun is **rising.**

Suppose some one sat all night and watched the spot where he saw the sun set. Would he see it rise next morning in the same place? No; we always find the sun in another part of the sky in the morning.

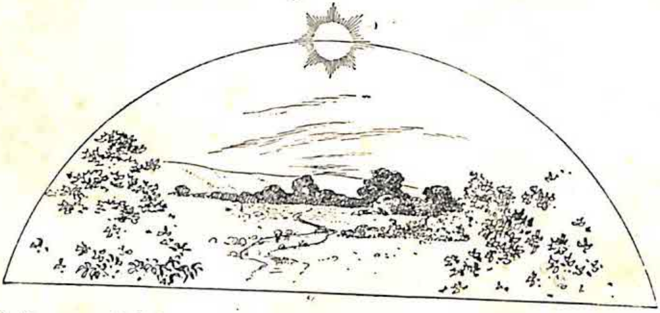
Explain that, if the watcher wished to see the sun rise in the morning, he would have to turn his back to that part of the sky where it set the evening before; **for it comes up on the opposite side.**

IV. EAST, SOUTH, WEST, NORTH

1. *Sketch on the black-board the curve or arch which the sun makes in its imaginary journey day by day across the sky. Trace the sun in its course along the arch.*

That part of the sky **where the sun rises** in the morning is called the **East.** We say **the sun rises in the East.**

Show that as it moves along the arch from the east, it is getting **higher and higher.** *When it reaches the highest point of the curve, measure with a tape, and show that it has now made* **half its journey.**



Elicit that this always happens at **twelve o'clock** *or* **noon,** *and show the reason why we call that part of the day* **mid-day** *or* **middle-day.**

When we look towards the sun at twelve o'clock, we are **facing the south.** The sun **rises in the east** in the morning; **at twelve o'clock it is in the south.**

2. *Continue to trace the course of the sun slowly and gradually along the other half of the curve, and observe that as it moves it is getting* **lower and lower down,** *till it reaches a point exactly opposite the east.*

Tell that this is where the sun disappears in the evening. We call this part of the sky the west. We say the sun sets in the west.

The sun rises in the east every morning; every day **at noon it is in the south;** and **it sets in the west.**

3. *This imaginary arch and the course of the sun across the sky should be made subjects for* **daily observation by the class.** *The sun* **streaming in at a certain window**—*always the same one—just as the class is being dismissed at twelve o'clock, or* **shining over some fixed object in the playground** *as they run off home, would thus become a familiar sight to all.*

From this it will be an easy step to point out that, as they look towards the sun in the south at twelve o'clock, they have behind them a part of the sky **where the sun is never seen.** This point **exactly opposite the south** is called the **north.**

SUMMARY OF THE LESSON

1. The sun is a great round ball of fire.
2. The clouds are nearer to us than the sun.
3. The sun rises in the east every morning, and sets in the west every evening.
4. The sun is in the south at noon. It is then at its highest point in the sky.
5. We never see the sun in the north.

Lesson IV

SUNSHINE AND SHADOW

The teacher will require a small paraffin lamp, and a spike, or stick of some sort, capable of being set up erect on a flat disc for observation from time to time.

I. How Shadows are formed

1. *Pull down the window-blinds, so as to shut out the daylight as far as possible, and then light the lamp. Notice that the lamp at once sheds its light in all directions, so that the room instead of being dark is now lighted up.*

Why is this? Because the air is transparent; **light can pass through it.**

Now stand one of the children in the middle of the room, and hold the lamp behind him. Call the attention of the class to the **dark patch on the floor,** *which begins at the child's feet, and* **stretches across the room in front of him.**

Point out that it is something like the boy in shape, only very much bigger.

2. What do we call this dark patch? We call it a **shadow.** It is **the shadow of the boy.**

Why does the lamp throw the boy's shadow on the floor? Because the boy's body is **opaque.** The **light cannot pass through it,** as it does through the transparent air all round.

3. *Show that his body actually stops the light from passing to that part of the floor, and so* **a dark shadow remains there.** *Hold the lamp in front of the boy, and let the class observe that the shadow is now* **behind him.** *Hold it on one side, and* **show the shadow on the other,** *and so on.*

Let the boy walk across the room, and the class will see that **the shadow moves as he moves.**

Hold up a variety of objects, and point out that :—

(*a*) **They all cast shadows** *if they are opaque, and*

(*b*) *The shadow is in every case* **similar in shape to the object** *which casts it.*

4. *Call attention to the length of the boy's shadow on the floor, and while doing so gradually raise the lamp, and let him walk slowly towards it.*

What do you observe now? As the lamp is raised higher, **the shadow gets shorter and shorter.**

Notice what happens when I hold the lamp directly over his head.

Where is the shadow now? There is **no shadow at all now.**

Hence we see from this that **when the lamp is low the shadows are long, when it is high the shadows are short.**

II. The Sun and its Shadows

1. We will put out the lamp, and draw up the blinds now, for we are going to talk once more about the **great lamp that shines in the sky**—the sun.

When the sun is very bright and hot, where do we like to sit? In a **cool shady place.**

Where do we find these cool shady places? Under a tree, or by the side of a wall **where the sun is not shining.**

Why is the sun not shining there as well as in other places? Because **the tree and the wall are opaque;** the sun cannot shine through them. It **casts a shadow of them** on the ground.

2. *Point out that it is cool as well as shady there,* **because the heat of the sun, as well as its bright light, is shut off.**

Tell that the sun (like our lamp) casts shadows of every opaque object on which it shines, and lead the children to tell *that on a bright, sunny day they always* **see their own shadows on the ground** *as they walk along—sometimes in front of them, sometimes behind them, and sometimes at their side.* **Sometimes the shadow** is **sharp** and **well defined,** sometimes it is **blurred.** Why?

3. *Refer to the experiments with the lamp, and ask them to* **measure one another's shadows** *in the open air at different times in the day.*

Remind them that when the lamp was low the shadows were long, when the lamp was high the shadows were short; and explain that they will find it exactly so with the sun.

At what part of the day is the sun highest? **At noon.**

What sort of shadows would you expect to find then? **Short shadows.**

When would you expect the shadows to be long? **Just before sunset.**

Why? **Because the sun is then very low down in the sky.**

4. N.B.—*This lesson, like others of a similar nature, depends for its full development upon constant observation in the open air.*

It would be well to note **by the aid of a spike set up erect on a flat disc** (*say in some convenient spot in the playground*) **the varying length of the shadow at noon** *throughout the year.*

For the present, and during the lesson, the teacher must of course be content with simple explanation, but he would have ample opportunity of verifying his statements, **by observation of the spike and its shadow from month to month.**

The noon shadow in the summer-time is **much shorter than it is in the winter.**

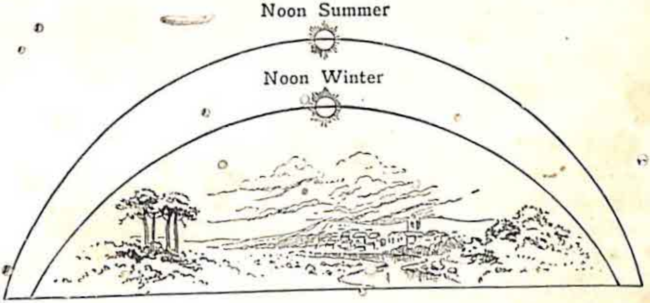
What does this tell us? It tells us that the sun at noon is **higher in the sky in the summer** than it is in the winter.

III. SHORT SHADOWS, LONG DAYS

1. *Draw an arc on the black-board showing the position of the sun at noon, and also its position at sunrise and sunset.*

This curved line represents the great arch in the sky **along which the sun seems to travel** from east to west.

We found just now that the sun is **not so high at noon in the winter** as it is in the summer. We will let this other curve represent the sun's winter journey.



At noon, you see, the sun is still in the same part of the sky, **exactly in the middle of the arch,** but it is lower down than it is in the summer.

Let us measure these two curves from the middle of the arch both ways. The **upper curve is much longer** than the other.

What does that mean? The sun has farther to travel in the summer than in the winter.

2. *Be careful to impress upon the children that* **the sun must reach the top of the arch** *(the middle of the journey)* **at noon,** *or twelve o'clock, every day whether it be summer or winter.*

Then as it has farther to travel to get to the top of the arch in summer than in winter, what must it do? **It must start earlier.**

What do you mean by that? **It must rise earlier.**

Explain that the sun does actually rise earlier—much earlier—in the summer than in the winter. **It rises hours before we are out of our beds.**

Proceed to show next that after it reaches the top of the arch at noon, the other half of the journey remains to be done.

The part of the day **from noon to sunset** is as long as the other part **from sunrise to noon.** In the middle of summer **the sun rises at about a quarter to four** in the morning, and **sets at about a quarter past eight** in the evening, making a very long day of sixteen hours and a half.

IV. LONG SHADOWS, SHORT DAYS

1. *Call attention to the other curve now. Remind the children that this represents the sun's winter journey, and that as before the sun must be exactly at the top of the arch at noon.*

Point out that as this winter journey is so much shorter than the summer one, it is not necessary to start so soon. **The sun rises much later in winter than in summer.**

Point out too that the second half of this journey from noon to sunset is as short as the first half.

The sun sets much earlier in winter than in summer.

2. *Tell that it is not easy for little boys and girls to see the sun rise or set in the summer, as it is up hours before they are out of their beds; and it does not set till long after their proper bed-time in the evening.*

But in the middle of winter (say on Christmas Day) every one may see both sunrise and sunset, provided it be a clear, bright day; for the sun does not rise then till about **eight o'clock in the morning,** *and it sets* **just before four o'clock in the afternoon,** making a very short day of less than eight hours.

As a matter for further observation in connection with all *this, the teacher would do well to note as far as possible* **the objects over which the sun is seen to rise and set from month to month.**

SUMMARY OF THE LESSON

1. Opaque things cast shadows, because light cannot shine through them.

2. When the sun is low in the sky the shadows are long; when the sun is high the shadows are short.

3. The noon shadows are shorter in summer than they are in winter.

4. The sun rises earlier and sets later in the summer than in the winter, and it also mounts higher in the sky at noon.

5. That is why the days are longer and warmer in summer than in winter.

Lesson V

CLOUDS IN THE SKY

Provide the teacher with Brown's pictures of the different kinds of clouds. A small kettle and tripod stand and the spirit-lamp will also be required.

I. INTRODUCTION

This lesson, from its very nature, like others of its kind, would have more interest for the children if a suitable day were selected for it, because then they would have actually before their eyes all the phenomena with which it deals.

With the rain falling fast outside, the teacher would naturally commence by making some remark about the wet day.

Boys and girls do not like wet days. They cannot play outside, but must remain in the house. Mother sends them to school with strong boots, thick coats, and umbrellas, so that they may not get wet.

But the rain is very useful to us in many ways. Suppose we try to learn something about it to-day.

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II. CHANGING FORMS OF CLOUDS

1. Where is the rain coming from? **From the clouds.** Where are the clouds? The clouds are **in the sky.**

What colour is the sky to-day? It is **a dull grey** colour.

Is it always this colour? No; it is sometimes **a beautiful blue** colour.

What do we then say about the sky? We say it is **a cloudless sky.**

Why is it dull and dark now? Because it is **covered with clouds.**

Lead the children to tell that the clouds are piled up so thick and close together to-day, that **we cannot see the sun's bright light through them,** *nor feel any of its warmth. The clouds shut it away from us altogether.*

We call clouds of this kind **rain clouds.**

2. But the clouds are not always the same as we see them to-day. It is only in rainy weather that they **cover the sky** as they do now.

We can almost always see **little white patches of cloud,** dotted over the blue sky on a clear bright day, and they look like patches of **loose white wool** or **feathers.** Clouds of this kind are known as **feather clouds.**

3. Sometimes, although the weather is fine, we see **great curly masses of thick dark clouds** moving across the sky. These are called **heap clouds.**

4. Sometimes too the clouds, instead of being piled up in curly masses, **stretch across the sky, low down, in beds or layers.** These we call **beds of cloud.**

Pictures of the changing forms of the clouds should be shown as the lesson proceeds, and of course the children should be encouraged to observe these appearances in the sky for them-

selves from time to time, and to draw their own inferences from them.

5. We sometimes see a great black cloud, **as black as ink**, come up and spread itself out, **till it covers the whole sky.** Then all of a sudden there comes **very heavy rain,** and perhaps **lightning and thunder** with it. This we call a **storm cloud.**

Remind the children that the rain from **the grey clouds** *which they can see in the sky now, has been falling all day long. The rain from those* **inky black clouds,** *although very heavy, is soon over. We call it* **a storm.**

III. What Clouds are made of

Now I daresay you would like to know what the clouds are. I will make a little cloud for you, and then you will be able to see for yourselves what a cloud is like, and what it is made of.

1. *The kettle, which to save time has been simmering all this while somewhere out of sight, should now be brought forward, and made to boil over the spirit-lamp.*

As it boils, notice that **something comes puffing out from the spout.**

What is this? What colour is it? What is there inside the kettle? Where did this steam[1] come from?

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[1] Of course it is not absolutely correct to call this white cloud steam, for real steam is invisible. But here we have an instance where it is better to meet children on their own platform, and be content with taking one step at a time. They know it as steam. Further explanations can come in the next lesson.

The steam, which you see coming out of the spout, is made from the water in the kettle. **It is a little cloud.**

2. What has changed the water into this little cloud of steam? The **heat** of the flame.

How long will the steam rush out of the spout in a cloud like this? Till all the water in the kettle **has boiled away.**

3. Now I want you to notice what happens when I hold this wet slate in front of the fire. You see there is **another little cloud rising from the slate,** just like the steam which is coming out of the spout of the kettle.

What is causing this? The **heat of the fire** is changing the water on the slate into **a cloud.**

How long will this go on? **Till the slate is quite dry.**

4. Do you know what would happen if I stood the wet slate out in the hot sun? The slate **would soon get dry.**

Why would it get dry? Because **the water on it would be changed,** as the water on this one was, and then it would **fly away in a cloud.**

What would change it? The **heat of the sun.**

Yes; heat always changes water into the form of cloud in this way.

Picture the wet clothes hanging out on the lines on washing day. When mother takes them in they are quite dry.

What becomes of the water in them? It changes into cloud and passes away into the air.

Tell of **the sun's great heat,** *and its action on water everywhere. It acts just as it does on the wet clothes and on the wet slate.* **It changes the water into the form of a cloud.** *This is* **how all the clouds in the sky are formed.**

IV. WHY THE CLOUDS FLOAT IN THE SKY

1. Watch the steam as it still pours out from the spout of the kettle.

What becomes of it? It **rises** and **floats away** up to the ceiling.

I will now tilt the kettle till some of the water flows out at the spout.

What becomes of the water? Does the water float up into the air in the same way? No; the water flows or **pours down** into the basin.

Why does the steam rise and float about in the air? Why does the water flow down?

2. *Put a stone and a piece of wood into the bowl of water, and deduce that:—*

(*a*) *The stone sinks because it is* **heavier than the water.**

(*b*) *The wood floats because it is* **lighter than the water.**

Be careful to impress upon the children that:—

(*a*) *Certain things float in water because the water is heavier than they are;* **the water presses upon them and forces them up.**

(*b*) *Other things sink in water because the water is lighter than they are; it cannot press upwards with as much force as the weight of these things presses downwards.*

3. Let us next find out what all this has to do with the cloud of steam from the kettle. We have seen it float up in the air just as other things float in water.

Can you tell me now why it floats? It must be **lighter than air. The air presses upon it and forces it up.**

And why does the water from the spout pour or flow down? Because water is heavier than air, and the air cannot hold it up; the water sinks through the air, **just as heavy things sink through water.**

Then why do the clouds float in the sky? Because they are lighter than the air; **the air pushes them up.**

Summary of the Lesson

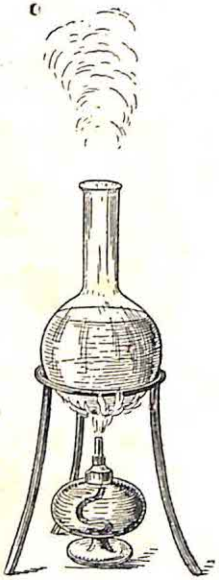
1. There are feather clouds, heap clouds, layer clouds, and storm clouds.
2. Heat changes water into cloud.
3. Clouds float in the sky because they are lighter than the air.
4. The heavy air presses the light cloud up.

Lesson VI

CLOUDS AND RAIN

Provide a small flask, a spirit lamp and tripod stand, a jug of water, a glass prism. Brown's pictures of the "Rainbow" and the "Clouds" should be shown.

I. Rain from the Clouds



1. *Boil some water in a flask over the spirit-lamp, and as the cloud flies off from the boiling water, call special attention to the flask itself. Point out that there is nothing at all to be seen in the mouth of the flask, and for some little distance above it.* **The cloud does not show itself till it reaches the air of the room.** *Hold one hand in this cloud, and pass the other (rapidly of course) between the cloud and the mouth of the flask.*

Why did I draw my hand back so quickly? Because the steam would scald it.

But I cannot see anything at all near the top of the flask. There is a big cloud just above it. I can hold my hand in that, without getting it scalded. Where is this scalding steam?

2. *Explain that the steam, when it first rises from the boiling water,* **is as hot as the water itself.** *It would scald us badly. That is the real steam, and* **we cannot see it** *as it comes from the flask,* **because steam itself is invisible.**

Hold a cold slate in the midst of it, and show that it **turns into actual water again,** *as soon as it touches the slate. Call attention to the drops of water, as they trickle down it.* **Steam changes into water as it cools.**

The white cloud, in which I am still holding my hand, is steam that is **already changing back into water.** We do not see it till it begins to change, and then **it is no longer actual steam.** This little cloud is not really steam, but **water-vapour.**

3. It was **water-vapour,** not steam, that we saw coming from the spout of the kettle the other day. It is water-vapour, not steam, that we see flying out **from the funnel of the railway engine.** It is **water-vapour** that **forms the clouds** in the sky.

Point out that the air of the room, although not cold enough to change this steam into drops of actual water, is sufficiently cold **to make it begin to change,** *and in that state it becomes* **water-vapour which we can see** *in a cloud above the flask now.*

Hold the hand again in the cloud above the flask for a short time, and let the children see that, when it is removed, **it is quite wet. The water-vapour has made it wet.**

4. This water-vapour is **so much lighter than air,** that the air forces it up, and **it floats about in the sky as a cloud.** But when it gets cold, the little particles of vapour run together, and are **changed back again into water,** just as we saw them changed on the cold slate.

Water is heavier than air, and therefore cannot float in the air. It sinks, and **falls down to the earth as rain.**

II. THE WIND AND THE CLOUDS

Pass on next to consider the clouds in the sky once more. They are not all the same shape and size. They are always changing. Sometimes they are in **little patches**; *sometimes they are* **piled up in great heaps.**

They do not always remain in the same part of the sky. They move about, and **it is the wind that blows them about in the sky.** *We may sometimes see the clouds* **driving onwards** *so quickly, that they almost look* **as if they were chasing one another** *through the sky.*

Then we see **one cloud break into another,** *and change its shape, as they drive on together.* **Sometimes they move slowly**; *sometimes they* **scarcely seem to move at all.** *Elicit as much of this as possible from the children's own observation.*

The wind does it all. It drives the clouds from one part of the sky to another. **The rain does not all fall in one place.**

III. RAIN-DROPS

Lead the children next to describe, in their own way, how the rain falls.

It does not fall in streams, as we see water come out of a spout or a tap. **It always falls in little drops.**

Dip a stick in a tumbler of water, and hold it up for the children to see the drop of water hanging at the end of it. Shake the stick, and ask them to describe the shape of the drop of water that falls from it.

It is **round like a ball.** It is **a little round ball of water.** The rain always falls in little round balls of water like this. We call them **rain-drops.**

N.B.—*It would be well, in connection with this, and on the first opportunity, to catch a few rain-drops on a dusty board, so that the children may note for themselves* **the size and shape of the drops,** *as they roll about in the dust.*

IV. THE RAINBOW

The phenomenon of the rainbow should form an interesting sequel to this subject, but of course it will require the simplest of treatment, and, if possible, it should be taught from actual observation.

1. OBSERVATION.—*Rainbows are often seen* **in the spray of cascades** *and* **fountains,** *when the sun is shining on them; and in suitable weather it is easy to make a bow in the garden during the watering operations.*

The watering-pot should be fitted with a long spout and **a fine rose-nozzle,** *and the experiment should take place* **on a bright, sunny afternoon,** *and* **as late in the afternoon as possible.**

When all is ready, hold the pot in such a position as to cause the falling drops of water from it to **pass through the direct rays of the sun,** *and a rainbow will at once appear. The same thing may be done with a garden syringe.*

Call attention to the succession of colours—**red, orange, yellow, green, blue, indigo, violet.**

Notice that the bow is **directly opposite the sun**; *that the sun is behind us as we look at the rainbow.*

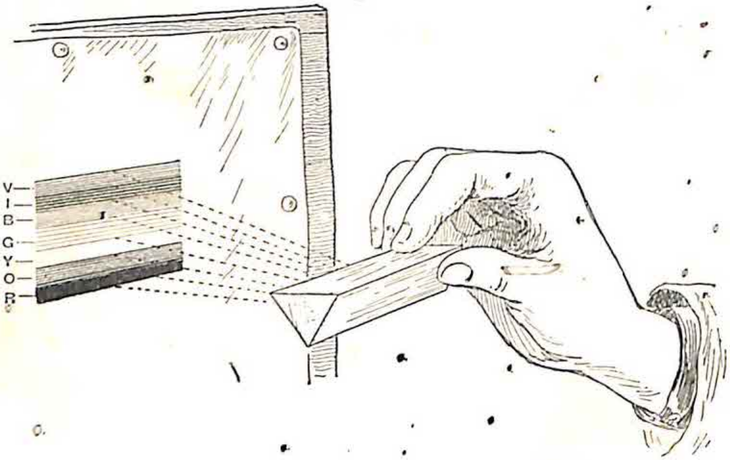
2. EXPLANATION.—*Let one of the children hold a glass prism in the sunlight now in front of a sheet of paper, and show that we get* **the same seven colours, in the same order.**

Tell that these colours are formed by the sun shining on the glass, and on the drops of falling water.

Remind the children of the shape of the drops of water. They are always round, or **ball-shape.**

Tell that it was **the roundness of all those little balls of water** *which gave our rainbow its beautiful arched shape.*

It is **the roundness of the rain-drops,** *which fall from the clouds, that makes the rainbow in the sky.*



On the first fitting opportunity that follows be careful to point out that the position of the rainbow is not always the same. It is **sometimes very high** *in the sky,* **sometimes low down** *near the earth.*

Tell that, the **nearer the sun is to the horizon,** *the larger and higher the rainbow will be.*

Rainbows are **only seen in the morning and evening**—never when the sun is high up in the sky as it is at noon.

It would be interesting in this connection to note the **rainbow colours on the mother-of-pearl of shells,** *and* **on the film of tar.**

SUMMARY OF THE LESSON

1. Vapour changes again into drops of water when it gets cold.

2. Water is heavier than air. The drops of water cannot float in the air. They fall as rain.

3. The wind blows the clouds about from one part of the sky to another. Hence the rain does not all fall in one place.

4. Rainbows are formed by the sun shining on the round rain-drops as they fall from the clouds.

Lesson VII

THE WIND AND THE WEATHER

The teacher should be provided with Brown's small model weather-cock, with movable parts as described in the lesson. A sheet of stiff drawing paper and a pair of scissors will be required.

I. INTRODUCTION

1. *THIS lesson would be best given in the course of an out-door ramble. The teacher might introduce his subject in the most natural way by calling attention to the farm-hands at work on the land. The children even at this age are very fairly conversant with the kind of work they see going on. Lead them to tell all they can about it in their own simple style, assisting of course where necessary, and then elicit further that we do not find this same kind of work going on at all times in the year.*

Encourage them to tax their memories, as to the special work which goes on at special times, and so lead up to the fact that most of the farmer's work is **out-door work.**

2. *Point out that such work cannot be done in heavy rain, reminding the children at the same time of the necessity of rain for the growth of the crops.*

The farmer's work **depends very much on the weather.** He has to watch the weather very closely, so that his men may not stand about idle. When it is going to be wet, he finds them something to do indoors.

How does he know what kind of weather to expect?

Explain that he learns all he wants to know about the weather **by noticing the wind.**

3. *The children have probably learned to fly kites. Lead them to tell that they have to take their kites into different positions at different times.*

Why is this?

Remind them too of the smoke from the chimneys. It does not always blow in the same direction.

Why? **The wind does not always blow from the same quarter.**

II. WARM, COLD, WET, DRY WINDS

1. *Call attention to the sun, and assist the children to point out its position at twelve o'clock (noon). Elicit that this is called* the **South.** *Explain that sometimes the wind blows from the south.*

Such winds come from the **warm, sunny lands. A south wind is always a warm wind,** and brings us **warm weather.**

Face the south now, and tell me what we call the point directly behind you. This is called the **North.**

2. *Remind the class that we never see the sun in the north part of the sky. Tell them that far away in the north there are lands where there is* **nothing but ice and snow all the year round.**

What kind of winds should we expect to get from those quarters?

The winds which blow from the north are **cold, biting, freezing winds.**

You know the little song that begins—

> The north wind doth blow
> And we shall have snow.

Explain that during the cold winter weather the winds mostly blow from the north.

3. What do we call that part of the sky where the sun sets in the evening? The **West.**

Let the children point out the west from where they stand, and then proceed to explain that winds which blow from this quarter **come across the great wide sea.** *Elicit step by step what happens:—*

These are **wet winds,** because they are loaded with clouds of vapour, which they have sucked up from that great body of water. These **west winds** are the **winds which bring the rain.**

4. Now tell me the name of that part of the sky where the sun rises every morning? The **East.**

As before, have the direction pointed out, and tell that winds which come from this quarter drop all their moisture in rain, as they blow over other lands.

These **east winds bring no rain,** for they have no clouds. They are very **dry, stinging winds.** They chap our hands and faces and lips.

The farmer knows all about the winds. As soon as he gets out in the morning he finds out from which quarter the wind is blowing, and then he knows what weather to expect. To help him in this he generally has a **weather-cock** on top of the farm-house or some of the farm-buildings.

III. THE WEATHER-COCK

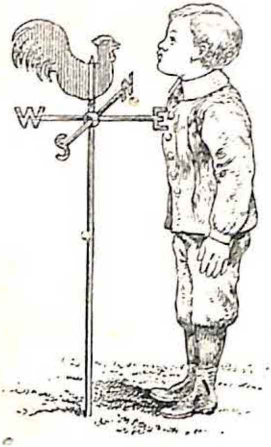
1. *There should be no difficulty in showing the children an actual weather-cock, either on some of the farm-buildings, the blacksmith's shop, or the school. Call attention in the first place to the four arms pointing in four different directions N. E. S. W. and explain the meaning of them.*

These four arms are fixed. They point out the four directions—**North, East, South, West.**

Notice that **the figure of the bird** *above these four arms* **is not fixed.**

It moves about as we are watching it.

2. We want now to learn something about this weather-cock, and in order that you may understand it clearly, I have got a model of one to show you.



Fix the spike in the ground, and let one of the children place it so that **the four points are in the proper positions.**

That done, place the bird on the top of the spike, and show by touching it that **it moves round easily.** It points sometimes one way, and sometimes another.

The four arms with the letters N. E. S. W. at the ends of them are fixed, so that **they always point in the same direction.** Why should the bird be made to move round easily in this way?

IV. WHY IT MOVES

1. *Instruct one of the children to blow as hard as he can against the bird. Observe that* **the bird at once spins round,** *and* **looks him straight in the face.**

Call upon several others to repeat the blowing from different positions, and let the class see that the result is always the same. The bird each time spins round **till its head faces the child who is blowing.**

2. Have you been able to find out yet why the real weather-cock moves round? It must be **the wind that blows it round,** just as our breath blows this one round.

Quite right. But why does the head of the bird always face the wind? This is a puzzle which we must find out.

3. *Cut out in stiff drawing-paper a figure of a bird, exactly*

like the one that has been used, make a couple of slits in it about the middle, and fix it up on the spike.

Show that this moves round readily enough when we blow against it, **but it does not each time face the direction from which the wind comes.**

Remove it now, and make two other slits, **much nearer the head than the tail of the bird.** *Show that when the spike is passed through these two slits, the bird not only moves round, but* **always faces the direction from which the wind is coming.** *It cannot be moved from that position while the wind comes from the same quarter.*

Point out now that the bird on the model is, in the same way, fixed to the spike **much nearer one end than the other.** *Tell that this model is exactly like the real weather-cock on the roof of the building.*

4. But we have not yet found out the puzzle. We still want to know why it is that the bird always faces the wind.

Lead the children to compare the big broad tail-end of the bird on one side of the spike, with the small slender head on the other side.

Point out that when the wind blows, **this big broad part catches more of it than the other parts,** *and so it is* **blown back** *as far as it will go. It is in this way that the head always faces the wind.*

N.B.—*The children should be encouraged to make a rough-and-ready paper contrivance for themselves, similar to the one just used. In doing so, point out that the one thing necessary is to make the slits nearer the head than the tail. It will then move easily round on a smooth lead-pencil when it is blown, and always face the person who is blowing.*

SUMMARY OF THE LESSON

1. There are warm winds, cold winds, wet winds, and dry winds.

2. The north wind brings cold weather; the south wind warm weather.

3. The east wind is a dry stinging wind. It chaps our skin.

4. The west wind brings the rain.

5. The weather-cock tells us which way the wind is blowing.

6. When it points out the quarter from which the wind is blowing, it tells us what kind of weather is coming. That is why it is called the weather-cock.

Lesson VIII

PLANTS

Articles required for illustration: a few cultivated plants of different sorts in flower-pots, a bunch of wild flowers according to the time of year, a few common leaves, a twig showing bursting buds, and some pieces of clay, chalk, and flint.

I. A Bunch of Wild Flowers

1. *Place the flower-pots on the table, and lead the children to talk about "the pretty flowers," as they will naturally call them.*

Carefully avoid for the present any mention of the word "**plant.**" *It will be best to commence from the child's own standpoint, and gradually deduce the new name as the lesson proceeds.*

Where did these pretty flowers come from? They came from the garden. Where else do we find flowers? We find them in the fields, in the green lanes, and in the woods. *Show the collection of wild flowers.*

2. Can we always find flowers there? No; there are **no flowers in the cold winter time.**

Explain, as the reason for this, that the flowers like warm sunny weather; they do not like frost and snow.

Remind the children that as soon as the snow and ice are *all gone the flowers come again, and stay with us as long as the warm weather lasts.*

3. We are going to see what we can learn about these beautiful things now.

Compare the specimens in the pots one with another, and lead the children to notice that :—

(*a*) *They are* **not all alike in appearance.**

(*b*) *Each one has* **several distinct parts.**

(*c*) **One part is not like another.**

Let the children themselves point out these different parts, and then proceed as follows :—

II. MADE UP OF DIFFERENT PARTS

1. THE FLOWER.—Come and show me the part in all of them which you like best.

What do we call this part? We call it **the flower** or **the blossom.**

Take the pots one by one, and lead the children to point out :—

(*a*) *That each specimen bears a particular kind of flower,* **and none other.**

(*b*) *That the flower of one is* **not like the flower of another.**

Compare these with the bunch of wild flowers on the table. It is equally true of them.

What is the first thing you notice about all these flowers? They are **not all the same colour.** Some are red, others are white, yellow, blue, pink.

What else can you see? They are **not alike in shape and size.**

Now let us pick some of them, and examine them a little more closely.

Do so, and lead the children to observe, as they handle them, that they all have a **soft, smooth, glossy surface.**

Show how **delicate and tender** *they are. The least* **rough handling will bruise** *and tear them.*

Lastly, hand the specimens round the class for the children to smell. They learn from this new sense of smell that some of the flowers **have a delicious scent,** *while* **others have no scent.**

2. The Leaves. — That will be enough about the flowers for the present. Suppose we turn to something else now.

Pluck one of the leaves, and hold it up before the class.

What is this? It is a **leaf.**

What colour is it? It is **green.**

Compare it with the other leaves, and lead the children to tell that they are alike in colour, for **they are all green.** *They are* **not like the flowers** *in this respect, for flowers have many different colours.*

Set a child to find some other leaves exactly like this one. Call upon the rest of the class to observe that he can find them on one of the specimens, but not on the others, and so lead them to tell that :—

(*a*) *Each bears its own particular kind of leaf,* **and none other.**

(*b*) *The leaf of one is* **not like the leaf of another** *either in shape or size.*

Hand a few leaves round the class now for closer inspection, and lead the children to compare them with the flowers they have already examined. Their sense of touch will readily show them that the leaf in each case, instead of being soft, smooth, and delicate like the flower, **is much thicker, coarser,** *and* **rougher.**

Show the reason for this by eliciting that the leaves have to **last longer than the flowers.**

3. The Stem.—*Pass on next to consider the part which stands up from the soil in the flower-pot. Explain that this is called the* **stem** *or* **stalk.**

Examine each specimen separately, and point out that one has **a single stem,** *another has* **several;** *that the stem of one looks stouter and stronger than that of another, and so on.*

Tell that the purpose of the stem is to raise the leaves and flowers up **towards the light and air.** *Point out the little slender stalks, which join the leaves and flowers to the stem.*

We call these **the leaf-stalks,** and **the flower-stalks.**

Now I want you to think about the trees and bushes, as you see them in the cold weather, when the snow is on the ground.

What do they look like then? They are bare in the cold weather; **they have no leaves.**

What do you notice on them when the cold weather is all gone? There are **little pale-green knobs** here and there. These get bigger and bigger, until at last they burst out into real leaves.

Do you remember what we call these little green knobs, which grow into leaves? We call them **buds.**

Show specimens of buds just bursting into leaf. Tell that the buds are sometimes called the **cradle of the young leaves.** *Explain.*

4. The Root. — We have spoken of the stem, the buds, the leaves, and the flowers. Is there not some other part which we cannot see? Yes, **the root.**

Why don't we see the root? Because it is fixed and hidden away in the soil.

Turn one of the plants carefully out of the pot, and show this hidden part.

Point out that it is joined to the bottom of the stem, and **stretches down into the soil.**

III. Uses of the Root

1. *Call attention to the specimens in the pots once more. The leaves look fresh and green, and the flowers are bright and gay.*

What must we do if we want to keep them so? We must **water them.**

What would happen if we did not give them water? **They would die.**

Then do you mean to say that all these things in the flower-pots are alive? Yes, **they are alive now**; but **they would soon be dead,** if we did not give them water.

Picture the grass in the hot dry weather. It becomes scorched up and withered for want of rain.

2. *Show a dead plant, and compare it with the living ones.* This one died for want of water.

Where do we put the water? We pour it into the soil in the flower-pot.

What good does that do? Let me show you.

Turn a plant out of the pot, shake the earth from the roots, and call attention to this part.

Explain that it is the root, in every case, which keeps these living things alive. **The root sucks up food out of the soil to feed them.**

3. *Remind the children that the specimens in the flower-pots were not always as big as they are now. They were* **very small at first,** *but* **they grew bigger and bigger** *from day to day.*

Tell that, like other living things, **they cannot grow without food. The roots find food for them in the soil,** if we keep it moist.

Refer to the sponge and its power of sucking up (absorbing) water into its pores. Explain that the root is something like a sponge in this. It **can suck up moisture,** *but it* **could not suck up the dry soil.**

This explains why we must keep the soil in the flower-pot moist by watering it, if the root is to find the food it wants.

Lead the children in the next place to think of these growing things in the garden during the wind and rain. Another *purpose of the roots will then quickly force itself on their minds.* **The roots hold them firmly in the soil.**

4. *Proceed lastly to gather up the teachings of the lesson one by one, and explain that things which* **live and grow in the ground, get their food from the soil itself,** *and have a* **root, stem, leaves,** *and* **flowers,** *are called* **plants.**

Elicit from this that not only the flowers in the flower-pots, but **trees** *and* **bushes,** *the farmer's* **corn** *and* **other crops,** *the* **grass** *and* **wild flowers—things of every kind that live and grow in the ground—are plants.**

SUMMARY OF THE LESSON

1. Things that live and grow in the ground are called plants.
2. Plants have several distinct parts, and one part is not at all like another.
3. The root feeds the plant with food which it sucks up out of the soil.
4. The root holds the plant firmly in the soil.

ROUND ABOUT THE FARM

INFORMATION FOR THE TEACHER

In dealing with these subjects the teacher must not lose sight of the fact that **the character of the farm,** *and* **the nature of the work** *to be done on it, will always* **depend upon the locality.**

Thus in certain parts of the country one might walk through miles of meadow and pasture **without seeing a single field of corn-land, or arable land** *of any kind. The farms in such districts are all* **grazing** *or* **pasture farms.**

The farmer is occupied either in rearing and feeding cattle, sheep, and pigs for the market, or in keeping cows for the sake of milk, butter, and cheese.

Then again in some districts **the land is nearly all under the plough.** *Corn and other crops are grown, but as* **pasture is scarce,** *cattle-rearing for milk, butter, and cheese is out of the question. These are* **arable farms.**

Again, in other parts of the country arable and grass land are pretty fairly distributed, and here we have **mixed farms,** *where the farmer* **raises suitable crops on his arable land,** *and at the same time* **rears stock on his pastures,** *and in many cases* **makes butter or cheese, or both.**

Hence it is impossible to frame any one **typical lesson** *or* **description** *which shall fit the conditions of all farms, for the nature of the land—arable, pasture, or both—settles the question as to the kind of work to be done in each case, and this in its turn* **settles the character of the farm-yard and its buildings.**

The buildings and surroundings of a purely grass farm, in a butter or cheese district, differ in many respects from those of an arable farm in a corn-growing part of the country.

On the **grass farm,** *for example, there are* **no corn-ricks** *to be seen in the stack-yard; there are no such things as* **reaping-machines, threshing-machines,** *or* **granary,** *for no grain is grown. The cattle are housed through the winter* **in open cow-houses,** *where they are* **tied up in the stalls**; *and of course* **the dairy is one of the most important buildings** *on the farm.*

A purely **arable farm,** *on the other hand, has* **no dairy** *worth mentioning, and the cattle, when they are housed at all, are kept in* **fold-yards** *or* **crew-yards,** *which are* **sometimes open to the air** *and* **sometimes roofed in.**

On **mixed farms**, *again, the conditions being different,* **the buildings and surroundings are also different.** *In one case, where milk is an important product, the cows may be found in the winter-time* **stalled in open cow-houses,** *like those of the purely grass farms. In another* **the fold-yard takes the place of the cow-house,** *and so on.*

Of course, in farms of every description there must be **stables, waggon-houses, implement houses, piggeries, chaff, mangel and other food houses**; *and there is always a* **barn,** *although it is not used for the same purpose in every case.*

N.B.—*The object of these introductory observations, needless to say, is not to teach the teacher, who doubtless knows thoroughly the conditions of his own district, but to give him a hint as to his mode of procedure in dealing with this very broad subject.*

In each case it would be well **to begin at home,** *by examining on the spot all that the children themselves are* **more or less familiar with,** *in their every-day experience, showing the reason why certain things are done in such and such a way. Then, in a subsequent recapitulatory lesson, in the schoolroom, the class should be led, with the help of pictures and diagrams,* **to compare the farm which they know** *with others working under different conditions.*

Lesson IX

A RAMBLE IN THE FIELDS

N.B. — *The lesson is arranged* **for a district of mixed farms,** *and in all such situations the teacher will find his course clear enough. Those in other districts will experience no difficulty, if each one selects for investigation whatever applies to his own particular case, and deals with that first, and on the spot if possible. It will be an easy matter afterwards by way* *of comparison and contrast to lead the children from the known to the unknown.*

Brown's pictures of the various meadow grasses, as well as dried specimens of the same, should be ready for recapitulation work in class.

I. INTRODUCTION

This lesson from its very nature would be best given during an out-door ramble, and perhaps late autumn would be the most suitable time for it. Needless to say, a fine dry day should be chosen for the excursion.

1. *Tell the children that the object of our ramble to-day is to see what we can learn about the ground we walk on.*

Lead them in the first place to notice that the land in one part is **covered with grass**—*that they never saw it anything but green.*

Elicit that this is known as **pasture-land,** *or* **meadow-land.**

2. *Turn next to the field close by. Elicit that this is not always as they see it now. It is* **quite bare now,** *but when the frost and snow are all gone, and the warm weather begins to come again, it will be* **green** *too, for* **the young crops will then begin to grow.**

Why is it bare now? Because the farmer has **ploughed it up** with the plough.

Why does he do this? He must plough the land, **before he can sow his seed.**

3. *Lead the children to compare this with the similar operation of* **digging in their own gardens.**

This land then is known as **plough-land,** because the farmer ploughs it up to make it fit for growing his crops. It is also called **arable land. Arable land** means **plough-land.**

You see from this that the land on the farm is not all alike. Suppose we now try to learn something more about it.

II. PLOUGH-LAND

1. *Take the children into the ploughed field. Notice that the ground is turned up in* **long straight lines** *or* **ridges,** *leaving a trench, hollow, or groove between each ridge and the next.*

Ask for the name of these hollows. They are called **furrows.**

2. *Pass on next to another field, where* **the work of ploughing** *is actually going on, so that the children may observe for themselves* **how the ridges are turned up** *by the plough.*

Point out the peculiar form of the implement itself. Notice how easily it seems to **throw up the soil on one side only,** *as it moves along. It is made for this.*

Let the class watch and describe, in their own simple way, **the work of the horses,** *and* **the work of the man.**

All this is to be treated in a very simple manner here. It will be dealt with more fully in a later stage.

3. *Examine the ground closer now, and count the furrows. A difficulty may occur here. As the crown ridge, in the middle of each land, is formed by two turnings coming together, we find* **no regular furrow there.** How is this?

Explain that the turned ground on each half of the land lies towards the middle; the ground has been ploughed two ways. This leaves **an open furrow between each ridge and the next,** *but there is no furrow between the two turnings in the middle.*

4. *Let the children now take up a handful of the soil, and rub it in their hands.*

What do you notice? It **crumbles up** as we rub it, although it is soft and moist.

Tell that the farmer calls this **the soil**—*that part of the ground in which his crops grow.*

Why do plants require soft moist soil?

5. *Now let one of the boys probe the soil with a stick, and tell what he observes.*

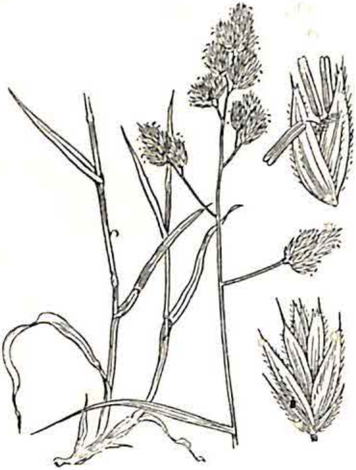
The stick goes readily through this turned-up soil, but it must be pressed very hard to force it into the ground underneath.

Explain that this under, harder part is known as the **subsoil. Sub** *means* **under.**

Tell (or elicit as far as possible) that this newly-ploughed land is not yet fit for sowing. The farmer must **harrow it,** *partly* **to break the clods of soil,** *and partly* **to level it.** *Promise to have a talk about this work later on. Compare it with the work of the* **garden-rake.**

III. PASTURE-LAND

IN THE MEADOWS.—*Pass on now into the nearest meadow. Notice that the grass is so thick that the soil cannot be seen; but* **the ground is firm to the tread** *as we walk along.*



COCKSFOOT GRASS.

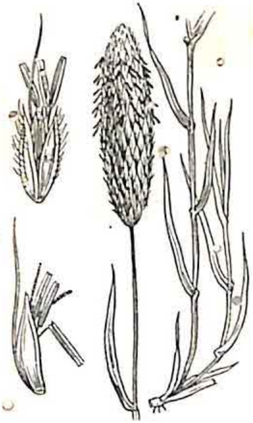
1. What is the difference between this and the plough land in the other field?

It is not ploughed year by year, as the other field is.

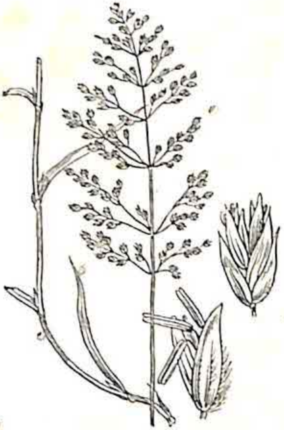
The farmer must plough and sow the other field every year; but he **does not plough and sow this meadow-land,** because the roots of the grass do not die away.

Lead the children to tell that **cattle eat the grass,** *and* *that it is also* **mown to make hay.** *Point out that in spite of this* **it still grows.**

As the season of the year precludes the possibility of gathering any of these meadow-grasses in flower, it would be well for the teacher to provide himself with one or two specimens from the school museum, such as the **Cocksfoot,** *the* **Meadow Foxtail,** *and the* **Rough-stalked Meadow Grass.** *Every country boy and girl should be familiar with these common varieties. Call attention to the seeds.*



FOXTAIL GRASS.



ROUGH-STALKED MEADOW GRASS.

These seeds fall on the ground, take root, and grow. **Hence new grass is always springing up.**

2. *Now dig up a tuft of the meadow-grass by the roots and shake it. Notice that* **the soil does not readily fall away;** *the matted roots hold it firmly. Work the soil away gently, and show the roots.*

What do you notice? The roots are **very fine threads,** and **stretch in every direction.**

Where does the plant get its food from? From the soil.

Tell that the soil of the meadow provides the roots of the grass with abundance of food. That is why the **meadow-grass** *grows tall, and* **produces rich crops of hay.**

ON THE HILL.—*A scramble up one of the hills would now be a good diversion for the children.*

1. *Let them notice as they go that the turf here is* **springy to the tread,** *and* **the grass shorter** *and* **more scanty.**

Examine the ground closely. Push in a stick, and cut up a piece of the turf.

What do you observe? We cannot push the stick very far into the ground. **The soil is not deep.**

Compare the turf with the piece brought from the meadow, in order to discover the following differences:—

The soil round the roots of the meadow-grass was soft and moist; this is **hard, dry, and gritty,** and is **easily shaken off the roots.**

The roots are **stouter** and **more matted; the grass is not so green,** and it is **more wiry** and **tough** than the meadow-grass.

Why is this? Let us see.

2. *Refer to the roof of a house. How quickly the rain runs off and leaves the roof dry. Explain that similarly* **the rain quickly runs off the hill-side,** *carrying away with it the softer part of the soil, and leaving a hard, dry, gritty soil to which the roots cannot cling. The sun too* **dries up the grass,** *making it hard and wiry.*

What do we learn from this? We learn why the **grass on a hill is not so good as that in the meadow.**

Why is that? Because the soil on the hill-side is poor and thin and dry. Grass requires moisture. **The grass on the hill-side does not produce hay.**

We get **hay in the meadows; turf on the hill-side.**

3. What animals feed on hill pastures? Sheep.

Why? *Remind the children of our hard work just now in climbing the hill. Picture the heavy labouring cattle trying to get along on the sloping sides of the hill. Sheep, on the other hand,* **can easily climb about,** *for they are light and nimble; and although the pasture is scanty, they can walk a long way in search of their food.* **Cattle would never get fat if fed on hill pastures.**

SUMMARY OF THE LESSON

1. The farmer has to turn his fields over with the plough, just as we dig up our garden with the spade.
2. He calls the fields plough-land because he ploughs them.
3. The ground must be made soft or plants could not grow in it.
4. The part in which the plants grow is called the soil; the part under that is the sub-soil.
5. Meadow land is not ploughed year by year.
6. The farmer wants the grass to keep on growing there.
7. We get hay in the meadows; turf on the hill-side.

Lesson X

THROUGH BOG AND WOODLAND

I. MARSH-LAND OR BOG

SHOULD there be any marsh or bog land in the neighbourhood, select it for the next ramble, and on the way lead the children to chat about the grass-lands dealt with in the last lesson.

Arrived at the spot, let the children attempt to walk upon it, and they will at once find that **it is wet and sloppy.** *They will say that* there is **water just under the grass.**

Pull up a tuft of this so-called grass and examine it, side by side with a tuft of meadow grass. Notice that **the stalks** are **stout**, and **the roots**, instead of being matted like the roots of grass, are **long coarse strings.**

Tell that properly speaking this is not really grass at all. We call it **sedge.** There is more stalk than leaf. The farmer would not give this to his cattle; they would not care to eat it.

Why is that, for the plants get plenty of moisture? The reason is, there is **too much moisture.**

Explain that although the soil requires rain, it is not good for the water to soak into the ground and lie there. It makes the land **a swamp or marsh.** Sedge will grow here; but it is too wet for grass.

Tell that the farmer **drains his land to get rid of the water.** *Show a drain-pipe, and explain in a simple way how the draining is done.*

II. Woodland

1. *The route taken should lead towards a wood or coppice. As it is approached notice how still, silent, and dark the wood seems to be; yet the children themselves know that it teems with life—* **squirrels, birds, rabbits,** *and* **hares.**

Instead of going straight to an opening, lead the children to where the brambles are thickest. They cannot get into the wood there; they must search along the hedge for an opening. In this way lead them to observe:—

That the brambles form **a thick fringe round the wood;** they do not grow very thickly in the wood itself.

2. *Enter the wood now, and compare the trees with those in the open fields as regards height and spread.* **The trees in the wood grow taller,** but they do not spread out so wide as those in the open. Let us find out the reason for this.

Notice how close together the trees are. In many parts of the wood **there is not room for another tree to grow.** *They are so close that their interlacing branches and leaves* **shut out the sky.** They do not spread out very far, because there is not room. **They grow taller instead.**

Why do they grow taller? Each tree tries to lift its head above the others into the sunshine. **Plants cannot live without plenty of sunshine and air.**

3. Where do these young trees come from?

Pick up a few **acorns** *and* **beech-nuts.**

What are these? They are **the seeds of trees.** They fall in thousands from the trees every year. The squirrels and other animals in the woods feed on them, but here and there one of these seeds takes root and springs up into a new tree. **All the great trees grew up from little seeds like these.**

Carry some back to school for future reference.

Speak of the corn and grass seed, and promise to explain some day how seeds grow.

4. *Now ask a few questions as to the uses of the* **trunks of trees,** *leading up to the question :—*

What trunks supply the best timber? Those that are **straight, thick, and tall.**

Why then do we let trees grow together in a wood or a coppice? Because **they grow taller there,** and make most useful trunks.

N.B.—*The teacher should not fail to seize this opportunity of calling the attention of the children to the* **poisonous plants** *so common in all woods, and especially to those whose showy berries are sure to attract and entice them. It will be sufficient for the present to point them out, and warn the children against them. They will be dealt with more fully later on.*

III. MOORLAND

In districts where it is possible, it would be interesting to follow this up by comparing the soil and growth of the moorland with the cultivated soils. There **the rocky nature of the ground** *and the* **thin scanty covering of soil** *allow of only a* **thin scanty herbage.** *Such land is not worth the work of cultivating.*

The character of the vegetation of the heath or moorland will be dealt with later on.

IV. CLASS-ROOM WORK

The facts dealt with in this and the preceding ramble should be recapitulated in school, **with the help of the pictures,** *while the subject is fresh in the children's minds. The blackboard summary would read as follows:—*

Plough-land or **arable land** must be ploughed before the seed is sown.

a. The **soil** is **soft, moist,** and **crumbly**; the **sub-soil** is **firm.**

b. The land is ploughed in ridges; an open furrow or **trench** is left between the ridges.

Pasture-land grows grass for feeding sheep and cattle.

a. The grass plant does not die when its leaves are eaten by the cattle, or cut to make hay.

b. The sub-soil of meadow-land is very deep. **Meadow grass produces hay.**

c. The grass on a hill is **not so good as that** in a meadow.

d. Sheep feed on it, but **it is not cut to make hay.**

e. The soil is gritty; **there is no sub-soil.**

Marsh-land is wet, swampy soil.

Sedge grows there; but **no grass for pasture.**

Woodland is land covered with trees.

a. Trees grow tall and straight in a wood.

b. Trees grow from small seeds.

c. Trees grow tall because they are all trying to lift up their heads above the rest to get into the sunshine.

d. These trees give the best timber.

Lesson XI

FIRST VISIT TO THE FARM-YARD

I. INTRODUCTION

The teacher should have visited the farm-yard himself previously, and be provided with a rough plan of it.

For the sake of comparison and contrast, plans are here given of a Somersetshire pasture farm, near Weston-super-Mare (see p. 55), and a Lincolnshire arable farm in the neighbourhood of Grantham (see p. 58), both recently visited by the author in connection with these lessons.

Winter-time would be best, as then the farm-yard is fully tenanted, and would have more interest for the children than it could have in the summer, when there would be nothing but empty houses to look at. It will be quite sufficient for the present to take a general survey of the farm-yard and its buildings, leaving all details for future lessons.

Choose a dry frosty day, and on the way to the farm lead the children to talk about the farmer and his work.

1. The farm is land on which crops of corn, roots, and grass are raised. The farmer is the man who works the land, and to help him in his work he uses many different tools, large and small.

By referring them to their own home-garden experience, elicit that the farmer must have buildings to put these tools in, when they are not in use. He must also have buildings in which to store the gathered crops, and houses for the horses and other animals he keeps on the farm.

The farmer lives in a house on the farm, with these buildings near. We call it the farm-house.

2. Why are these buildings near the house? Because they must always be ready to hand, **so that the farmer can look well after them,** and everything in them.

While passing the farm-house call attention to the neat, prim, well-cared-for look of the house. There are probably a smooth lawn and flower-beds in front of it. The children, or at least some of them, know how pretty these look in the summer-time, although of course they are bare and empty now.

Why are they placed here? Because they are **pretty and pleasant to look upon from the front of the house.**

But where are the buildings we spoke of? They are **behind** (or at the side of) **the house.**

Why? Because though useful they are **not pretty to look at.**

II. The Farm-yard[1]

1. *Proceed round the house to the farm-yard, and halt the class at the entrance, taking care to stand where the wind can be felt, and not in a place sheltered by the house.*

Where are we now? At the entrance of the **farm-yard** (or **barton**).

The farm-yard is a large open space, close to the farm-house, **with buildings round it.**

What is the use of this large open yard? It is large to allow **carts and waggons to turn and move about in it,** when carrying loads to or from the farm-buildings.

2. *Refer to the former lesson on the sun, and let the children point out its course in the sky from sunrise to sunset. Notice also the sunny and shady parts of the yard.*

Some of the buildings are on **the shady side of the**

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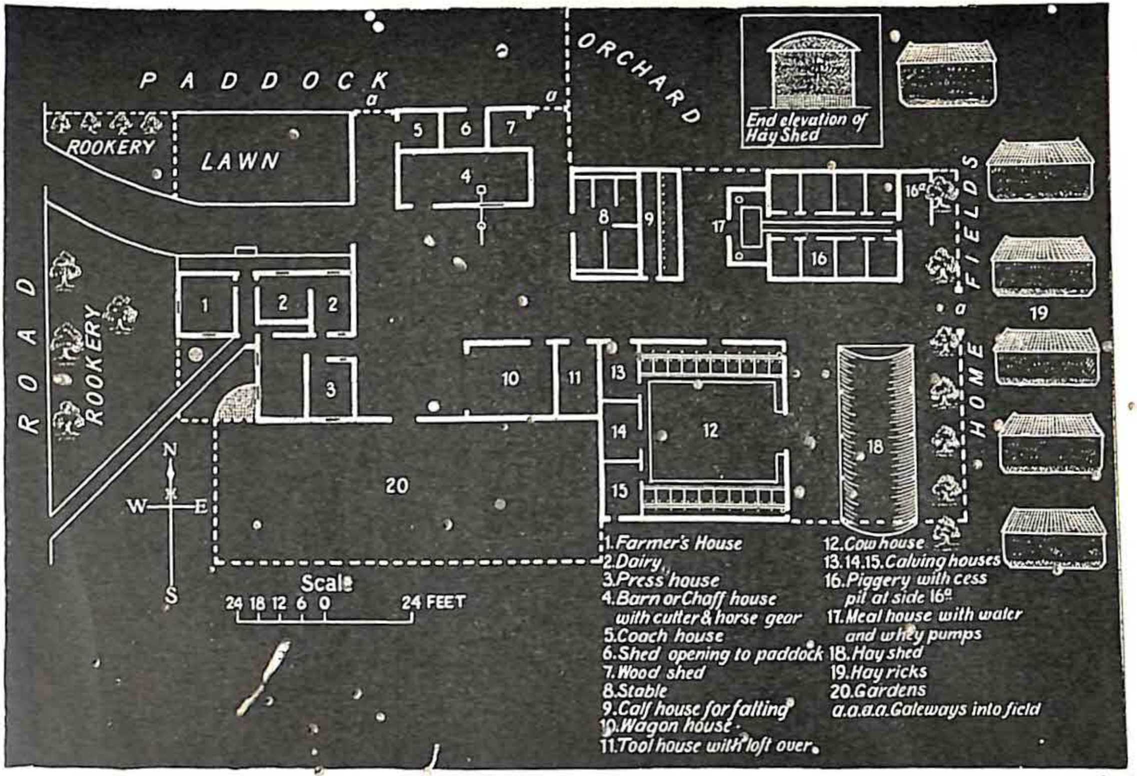
[1] Commonly known in the West of England as the **Barton.**


PADDOCK
ORCHARD
End elevation of Hay Shed
ROOKERY
LAWN
ROAD
ROOKERY
FIELDS
HOME
a
a
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N
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E
S
Scale
24 18 12 6 0
24 FEET
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2
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4
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6
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8
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10
11
12
13
14
15
16
16a
17
18
19
20
1. Farmer's House
2. Dairy
3. Press house
4. Barn or Chaff house with cutter & horse gear
5. Coach house
6. Shed opening to paddock
7. Wood shed
8. Stable
9. Calf house for fatting
10. Wagon house
11. Tool house with loft over
12. Cow house
13. 14. 15. Calving houses
16. Piggery with cess pit at side 16a
17. Meal house with water and whey pumps
18. Hay shed
19. Hay ricks
20. Gardens
a. a. a. a. Gateways into field

PLAN OF CHURCH FARM, LYMPSHAM, NEAR WESTON-SUPER-MARE, SOMERSETSHIRE.

yard, where they get less sun than the rest. This is not an accident; there is good reason for it. We will try and find out the reason by and by.

3. *Notice next the position of the farm-house itself with regard to the yard and the buildings round it.*

Observe that the **wind blows** *over the farm-house* **towards these buildings—not** *across the farm-yard* **to the house.**

N.B.—*The relative positions of the farm-buildings and the house in every case depend upon the nature of the prevailing winds. The two are so placed that the* **smell from the farm-yard cannot be carried into the house.**

Explain to the children in a simple way.

III. THE FARM-BUILDINGS

1. THE STABLES.—*Lead the children to think of the farmer's work. There is one animal that helps him in his work more than any other.*

Which is that? The horse.

Horses **work on the land**; horses **draw the heavy waggons and carts.**[1] The farmer has a **cob to draw his light carts**, and **his trap** which takes him to market.

Tell that, as these horses have to work hard, they **must be well cared for,** *if the farmer wishes to keep them* **strong and healthy.**

When their work is done they are put into these warm comfortable houses to rest. **They are the stables.**

2. THE WAGGON-HOUSE.—*Pass on next to the waggon-house, and notice the purpose to which it is put. Call attention to the* **waggons** *or* **wains,** *the* **putts** *or* **manure-carts,** *the* **light carts,** *and the* **farmer's trap.**

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[1] The heavy manure carts are known as **putts** in the West of England.

All these have to be housed to keep them from the weather. The farmer takes special care of his smart-looking trap in a little house of its own, which he calls **the coach-house.**

3. THE TOOL-HOUSES.—*Notice next these* **large open sheds,** *and the curious-looking* **machines** *that are kept there. Tell that these are* **the farmer's tools,** *with which all the work on the land is done.*

The children may be able to recognise some of them. Assist them in this, and tell in a simple way **the kind of work each one does.**

Explain that these tools cost a great deal of money. Hence the farmer keeps them in covered houses **to protect them from the weather.** *If they were left outside, they would soon* **get rusty and useless.**

4. THE CATTLE-HOUSES.—*The children all know that cattle live in the open fields during the greater part of the year. Refer to this now, and point out that there are no cattle to be seen in the fields to-day, because it is cold wintry weather.*

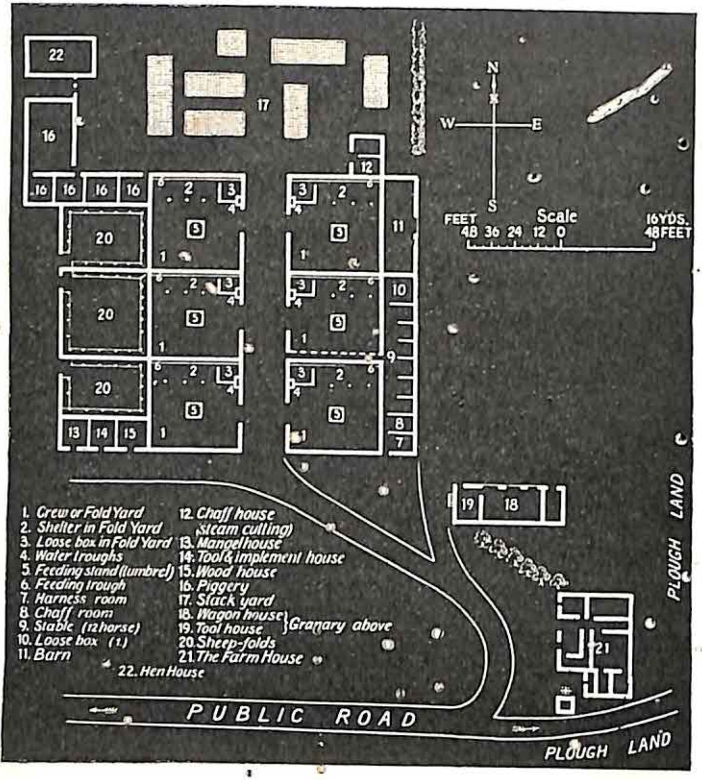
The farmer takes care of them in comfortable houses all through the winter. Let us have a peep at them in their winter homes.

Two types of cattle-houses are given here—**the cow-house of the pasture farm,** *and* **the fold-yard** *or* **crew-yard** *which takes its place on* **an arable farm.** *The teacher, of course, will deal with the one which fits his own locality.*

(*a*) **The Cow-house.**—This is a **large, open, airy building,** with **stalls for the cows** arranged side by side. **The cows are tied up** with ropes in these stalls during the winter.

It will be sufficient for the present to let the children peep in at the animals. The houses themselves will be fully dealt with in another lesson. The farmer keeps his cows in these houses, because he knows they would give **little or** no milk *if they were* left out in the cold winter weather.

(*b*) **The Fold-yard.**—This is a **large square yard**,



PLAN OF TEMPLE BRUER FARM, NEAR GRANTHAM, LINCOLNSHIRE.

sometimes **open to the air**, sometimes **covered in with a roof.** In Lincolnshire and Yorkshire it is known as the **crew-yard.**

Let the children have a peep at the animals in the yard.

Notice that they are **not tied up**; *they are* **free to move about** *as they please.*

These are **not cows for milking**, but animals which the farmer is rearing for the market.

5. THE PIGGERY.—The row of small houses where the farmer keeps his pigs is known as the **piggery**. These buildings are as a rule placed **at the far end of the farm-yard**—away from the house.

Notice that the **smell from these animals is more unpleasant** *than that from any of the others kept on the farm.*

The place smells even though it is kept clean. Hence the piggery is always built **as far as possible from the house.**

6. THE RICK-YARD.[1]—*It will be sufficient for the present to call attention to the place, and to explain that it is here the farmer* **stacks his hay** (*or* **corn**, *or* **both**), *according to the nature of the farm. Promise to visit this part of the farm-yard again.*

Notice **the hen-house** *in passing. It is usually placed somewhere in the neighbourhood of the rick-yard, although* **the fowls** *and the rest of the* **poultry seem to be everywhere.** *We meet with them at every turn.*

7. THE BARN.—*Point out this building: open the* **big folding-doors,** *and let them peep inside, to see what kind of place it is. Then tell the purpose for which it is used. Another visit should be paid to it later on.*

The barn is a large building consisting of just **the four walls and a roof.**

It has **no windows**; if we close the big doors we find it is quite dark.

The farmer uses this building as his store-house.

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[1] Called in the North and East of England the **stack-yard**, and in the West of England the **hay-barton.**

Those great doors are big enough to admit a loaded waggon.

The barn-floor is usually well raised above the ground, **to keep it up from the damp earth.** It must be kept dry.

8. THE GRANARY.—*Elicit from the children that the corn is stacked in the rick, just as it is carted from the harvest field—straw and all.* **The grain is still in the ear.** *Most of them have seen the work going on.*

What does the farmer do with the rick? He **threshes** it.

Why does he do that? **The threshing beats the corn out of the ears.**

Tell that after the corn has been threshed, **the grain is stored in the granary**—*a place made specially for the purpose. Hence the name. The granary is in most cases* a **sort of loft,** *or big room*, **over the waggon-house,** *the* **tool-house,** *or* **some other building.** *Let them have a peep at it, if possible.*

9. THE DAIRY.—*Make the dairy the last place to visit. Notice that this is the* **coolest and freshest building on the farm.** *Let the children peep in and observe how* **spotlessly clean** *the place is. Call attention to the* **large pans of milk** *standing on the shelves.*

Tell that milk would quickly go bad **in a warm room,** *or* **in a dirty place** *where there are* **bad smells.**

Pass out now and notice the position of this building. It is **on the north side** *of the farm-yard.* Why is this the coolest of all positions? Because **the sun is never in the north** part of the sky.

Point out that the dairy has no windows opening into the farm-yard itself. **No bad smells can get into it.**

SUMMARY OF THE LESSON

1. The large yard close to the farm-house, with buildings round it, is called the Farm-yard or Barton.

2. There are stables for the horses, waggon and tool-houses, cow-houses, houses for the pigs, and a barn.

3. The rick-yard is the part where the farmer stacks his hay and corn.

4. The dairy is the place where the milk is kept, and butter and cheese are made.

Recapitulation in class to follow, with Brown's picture of the "**Farm-yard.**"

Lesson XII

THE FARM STABLES

I. INTRODUCTION

On the way to the farm-yard for this second visit endeavour to lead the children to chat about the various buildings grouped round it, their relative positions, the reason why each is so placed, their uses, and so on.

The farmer's best friends are his horses. They do all his hardest work. To-day we are going to have a look at the stable in which he keeps them.

II. THE STALLS

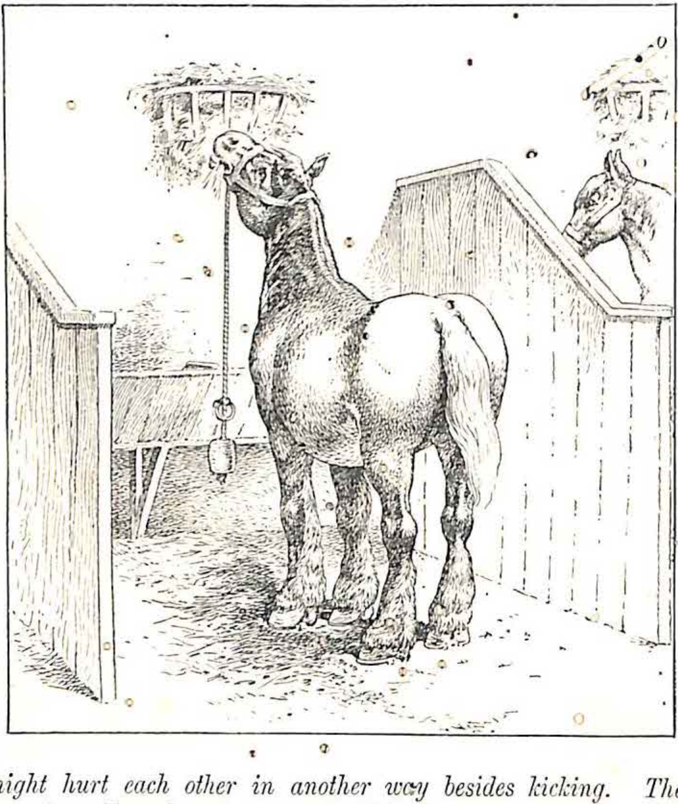
1. *On entering the stable call attention to the way in which it is divided off in separate compartments, or boxes, by wooden partitions. This will probably be one of the first things to attract the notice of the children.*

These boxes are the stalls. There is, as a rule, room for **two horses in each stall.**

Explain that the farmer usually places in the same stall two horses that **have got used to each other** *by working together.* They are **quiet** and **even affectionate** one to the other; **they never quarrel.**

But he **would not put two strange horses** *in the same* *stall.* They would most likely quarrel, and **kick and hurt one another** with their iron shoes.

2. *Notice next that the partition is much higher at the wall end than where the children are standing. Elicit that horses might hurt each other in another way besides kicking. They sometimes bite when they get spiteful.*



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This wall end is called **the head of the stall,** because the horse's head is nearly always turned that way. The wooden partition near the head is **higher than the rest,** to prevent one horse from biting the next.

3. *If there happens to be a horse in one of the stalls, call attention in the next place to the way in which it is tied up.*

The halter passes over the head behind the ears, and partly round the jaws. The **halter rope runs through a ring fixed to the manger,** and **there is a large round wooden block** at the end of it.

Watch the horse, and notice that the rope hangs straight no matter how it moves its head. Let a boy tie the end of one of the halter ropes to the ring itself, and then hold the halter in his hand, moving it up and down to imitate the motion of a horse's head. The rope now **forms a deep loop when the horse's head is low.**

Why not tie the horse up to the ring like this? Because it might easily **get its leg over this loop,** and in trying to get it back it might break or injure the leg.

Tell the children that this has sometimes been done owing to careless carters.

III. The Manger and Hay-rack

1. What does the horse do in his stall? He **feeds, rests,** and **sleeps.**

This will naturally lead the children to notice the **manger** *which was mentioned just now.*

The manger is a **deep wooden trough,** into which is put chaff, bran, beans, oats, and meal for the horse to eat.

2. But what is this **wooden grating above the manger?**

Explain that this is called **the hay-rack.** *The horse is very fond of hay. The hay is put into this rack, and the horse can easily pull it out in wisps through the bars.*

Notice that the halter rope must be long enough **to allow the horse's head to reach the hay-rack,** *although the wooden block at the end of it prevents it from hanging loose when he lowers it again.*

3. *Give the horse some hay to eat, and call upon the children to notice how he jerks his head, as he takes it out of the hand.*

Now, suppose the hay was put in the manger. The horse would soon have it all **under his feet.**

What kind of hay does the farmer give his horse? He always gives him the best. **A horse is very dainty with his food.** If we gave him poor, or mouldy, or even dirty hay, he would refuse to eat it.

IV. THE FLOOR

1. *Draw attention to the floor of the stable now. Notice that it is a* **stone-paved floor.** *Pour a little water on the floor at the manger end of the stall; it flows quickly* **away to the gutter,** *which runs along the opposite end.*

What does this tell us? It tells us that the stone floor **slopes downward to the gutter.**

Why is it made to slope in this way? The horse must be **kept clean and dry.** All water flows away at once, and leaves the floor of the stall dry.

2. *Now ask the children how they would like to sleep on a stone floor like this. Most of them will no doubt be ready to answer that the horse does not lie on the cold stones; he has* **a thick, warm bed of straw.**

Why is there no straw bed in the stall now? The horse would trample it under his feet as he moves about. The straw will be put down later in the day.

What is this straw? It is **the stalk of the corn.**

Tell that when the farmer takes the corn from the rick, and threshes the grain out of the ears, all that is left is straw. He then **stacks this straw** *up, to make* **warm comfortable beds for his horses.**

Straw makes the best of all beds. It is **warm**; it **allows the water to run away**; when it gets dirty it can be removed, and **a new bed put in its place.** On an arable farm the farmer always gets plenty of straw from his corn.

V. THE DOOR

1. Now, last of all, let us notice the door. It is divided across into two parts. There is **an upper half** and **a lower half.** One half can be shut, and the other half left open, or both of course can be shut.

The lower half is shut now. Let us see the reason for this.

The children will at once say that it is to prevent the horse from getting out. Remind them that the horse inside is tied up; it could not get out, even if the door were left open.

Point out that there are sometimes other animals in the farm-yard—**a pig, a sheep,** *or* **a calf.**

What might happen if either of these got behind that horse, which is tied up in the stall? The horse would very likely kick it, and so perhaps kill it.

The children themselves should be cautioned **never to approach a horse from behind without speaking to it.** *It is a timid animal, and is likely to start and kick at the least sound.*

Now you can tell me why the lower half of the stable door is shut? To prevent the horse from getting out, if loose, and to prevent other animals from getting in from the farm-yard.

But why not shut the top part as well?

2. *Refer to the school-room windows. We can open and shut them as we please.*

When do we open most of the windows? **In the hot weather.**

Why? **To let in the cool fresh air.**

Why not open them all in the cold weather? Because then the cold air would come in.

Now then you can tell me the use of this upper half of the door? It is left open in the hot weather **to keep the stable cool;** it is closed in the cold weather so that the stable may be **warm and comfortable.** Horses like to be comfortable.

N.B.—*The teacher must note that if the stable has not a divided door, then the stable window opens, and the same reasoning holds good.*

So then the stable is a house in which the horse can be kept **clean, comfortable,** and **dry, cool in the hot weather, warm in the winter.**

SUMMARY OF THE LESSON

1. There are stalls in the stable; there is room for two horses in each stall.

2. The horse feeds out of a big tray or trough called the manger.

3. The hay for the horse to eat is put in the hay-rack above the manger.

4. The horse has a thick warm bed of straw.

5. The stable is a warm cosy house for the horse.

6. The farmer takes great care of his horses and treats them kindly.

Lesson XIII

HORSES, CARTS, AND WAGGONS

I. INTRODUCTION

WE have seen already that horses are most particular animals. They like a clean comfortable stable and good food; they will not eat coarse or stale food. They are even **more dainty still over their drink.** Offer them dirty water, or even a dirty pail to drink from, and they will turn away from it, even though they may be very thirsty.

There is one other thing about which they are very particular. They like to be made **clean and comfortable** themselves. They don't like to be dirty.

II. THE STABLE-YARD

1. *Ask the boys to watch the horses some day as they come in from their work, and they will see that they are not taken straight into the stable directly they are unharnessed, although they are no doubt tired with their hard work.*

They have probably been out in the muddy roads or fields, and they are hot and dirty.

The man leads them to the paved yard in front of the stables, and at once sets to work **to wash their legs and feet.**

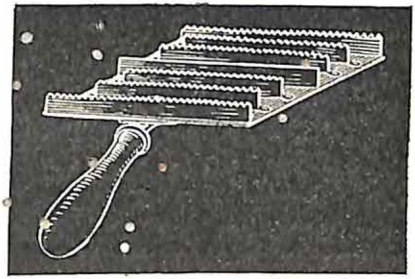
2. *Point out that this part of the yard in front of the stables is not like the rest.* It is **paved with stones,** and either at the side, or down the middle, there is **a gutter,** towards which the paving slopes. This gutter carries all the water away; **there are no dirty muddy puddles.**

Notice how quiet the horses stand while their legs and feet are washed.

Some animals would struggle if we tried to wash them. **The horse stands quite still;** he likes to be made clean and comfortable. His master has him washed when his work is done, and before he goes into the stable to feed.

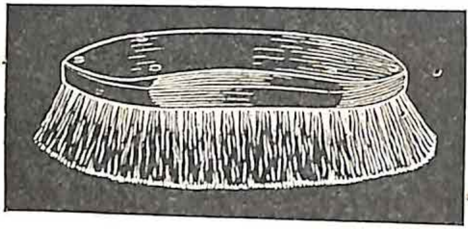
3. But does his body not want cleansing as well as his legs and feet? How is that done?

Send one of the boys to get the **curry-comb** *and the* **stiff brush** *from the place where they are kept in the stable. Notice the* **short iron teeth** *of the curry-comb.*



The curry-comb is used **to loosen and scrape off the mud** which clings to the body, and the stiff brush can then easily remove **the dust and loose hair.**

4. *Refer the children to their own bath at home. How much more comfortable they feel after a good wash on a hot day.*



When the horse has been made **clean and comfortable**, he is ready to go **into the stable to feed and rest.**

Now let us see what we have learned. Horses must be kept **clean.** They must have a **comfortable stable, good food,** and **clean water.** Great care must be taken of them in the stable, so that they may not hurt themselves or others.

They deserve good, kind, careful treatment from every one.

III. THE WAGGON-HOUSE

1. Why does the farmer take all this care of his horses? To keep them **healthy** and **strong.**

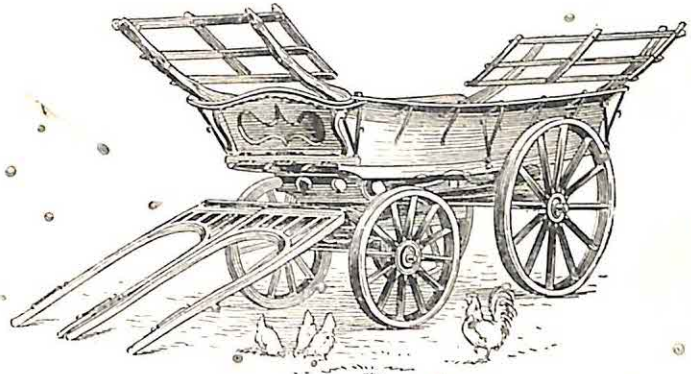
Why does he wish to keep them healthy and strong? Because his horses are very useful to him. They do all the **work in the fields,** and all the **hauling** or **carting.** They haul manure to the land, and crops to the farm. They also take him and his produce to market.

Note briefly the different kinds of horses he keeps. There is the great powerful **cart-horse** *for the* **waggons** *and the* **heavy carts,** *and for doing the* **hard work on the land,** *and there is also the* **cob for the lighter carts.**

2. Let us leave the horses now, and have a look at the carts and waggons which they draw.

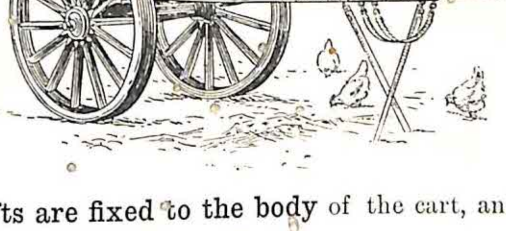
Take the children to the **waggon-house,** *and help them to examine and compare the* **waggons,** *and the* **putts** *or* **heavy carts** *as follows:—*

Both are heavy and strong, **with big wheels well bonded.** They have **no springs. The shafts** in each case are **thick** and **straight.**



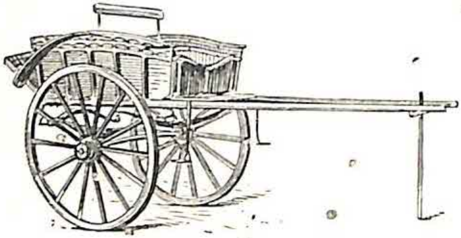
Set two of the boys to try and lift the **shafts of the putt or manure-cart** *and afterwards those of the waggon. They find them very heavy*—**too heavy to lift.**

3. **The putt has high sides,** with only **two wheels;** the **shafts are fixed to the body** of the cart, and move with it.



The **waggon,** or **wain,** has **long low sides,** with an **outward shelf** firmly fixed to them. It has **four wheels,** the two hinder of which move only with the body of the waggon, while the **front wheels are joined to the shafts** and move with them. *Point this out carefully, and show that it enables the waggon to turn in a small space.*

4. *Turn next to the* **spring cart,** *and set the same two boys to lift the shafts and pull.*



The cart moves. Why? Because it is not so heavy. It has **lighter wheels,** with **thinner shafts and sides.**

Why is it made lighter? Because it is not meant to carry such large heavy loads. The farmer rides about the farm in it, and also uses it to carry the churns of milk and other things.

Which would you like to ride in best? The cart.

Why? Because **it does not jolt so much** as the waggon or the putt.

How is that? **It has springs;** the others have no springs. We call this **a spring cart.**

5. *Picture the* **rough rutted lanes** *and the* **uneven fields,** *and so lead the children to tell that* the waggon and the putt, with their heavy loads, would soon **shake springs to pieces,** and make them useless. They are **best without springs.**

The cart is strong, but it does not carry heavy loads.

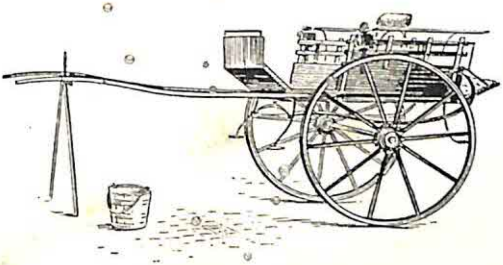
Call attention now to the **raids** *or* **hay-ladders of the waggon** *and heavy* **cart.** *Notice how they hook into the* *body of the waggon, for the purpose of enlarging it in front and behind.*

What is the use of these ladders? They **keep the hay and corn from falling out,** while the waggon is jolting along the rough road-ways. They are also called **harvest frames** or **shelvings.**

IV. THE TRAP-HOUSE

1. *Pass on next to the trap-house to examine the farmer's trap; and set one of the biggest boys to take up the shafts and pull. One boy can do it.*

See, the trap moves easily. It is **lighter than the cart.**



Notice that **the shafts** *of the trap are* **curved,** *and that it has a smart, bright appearance. The man keeps it very clean. It is carefully washed after it has been out. Refer to the difference between the spring cart and the waggon.*

The cart does not jolt so much as the waggon. Why? Because it has springs.

Call attention to the springs of the trap. They are lighter and more bent than those of the cart.

The trap runs more smoothly than the cart, **because its springs are finer and more curved.** It is easy, pleasant riding in the trap.

2. Where do we find all these carts and waggons? They are kept in houses.

Draw attention to the **houses** *themselves, and point out that the waggons and carts do not require so much care as the smart trap does. Even in washing this trap the man must be careful not to get it scratched.*

Why house them at all? Because they would warp and decay, if they were left out in the sun and rain. They would not last long.

SUMMARY OF THE LESSON

1. The horse likes to be kept clean. The men wash him and scrub him with the curry-comb and a stiff brush.

2. The horse will not eat dirty stale food; he will not touch dirty water.

3. The waggons and carts must be very strong. They do all the hauling on the farm. They move slowly.

4. They have raids or hay-ladders to keep the hay, corn, and other things from falling out.

5. The traps and other light carts have springs. They must run easily.

Lesson XIV (a)

THE CATTLE-HOUSES

THE broad distinction between these houses in different classes of farms, in different parts of the country, has already been pointed out in Lesson XI.

Both will be dealt with in this lesson, and the teacher of course will select the one which is common in his particular district. Having examined this one on the spot, he should take the earliest opportunity in the schoolroom of comparing it with those of other districts.

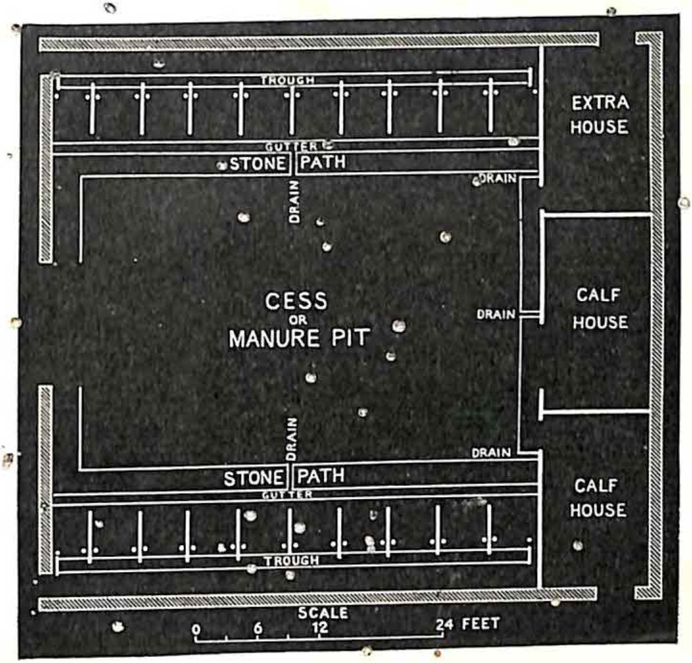
We will deal first with the **Cow-house,** *which is found on all the* **pasture farms in the West of England**; *and afterwards with* **the Fold-yards** *or* **Crew-yards,** *which take their place on the arable farms of* **Lincolnshire and**

the North, *and on* **large numbers of mixed farms** *in various parts of the country.*

I. THE COW-HOUSE

The teacher must carefully guide the class in exploring this building, lest some of its points, from their very familiarity, be passed over.

Notice in the first place that we enter the building by a wide opening in the end wall—**a sort of door-way or gate-way,** *except that there is neither door nor gate to shut. As soon as we enter, we catch sight of the stalls and the cows in them.*

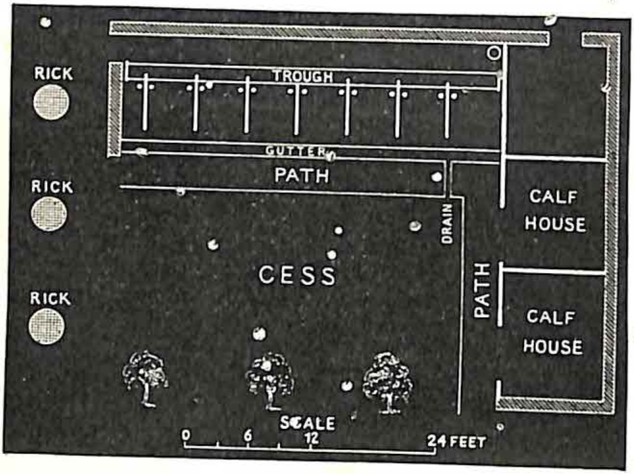


1. THE STALLS.—Let us examine the stalls first. **In**

large farms, where many cows are kept, there are **two rows of stalls,** ranged along the side walls of the building.

In smaller farms there is only **a single row of stalls,** and in that case a wall, a row of trees, or some other form of shelter takes the place of the second row.

Take the children **round the stone path,** *which runs along in front of each row of stalls, and call attention to*



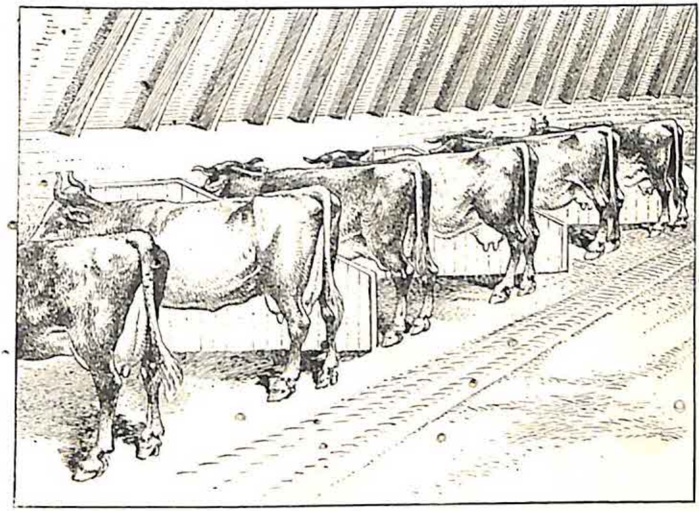
the gutter, *which empties into the large* **cess or manure pit,** *that takes up the whole of the space between the paths.*

The children know that, every time the cow-men clean out the stalls, all the **dung and liquid** *is swept down these gutters* **into the cess or manure pit.**

2. *Notice that* **the stalls are open;** *the roof is supported by a wall in the fore-stall, but there are only pillars to hold it up at the rear-stall.*

Each stall has room for **two cows.** *Point out the two wooden posts at the head of the stall, with the iron rings fixed to them.* **The cows' ropes or ties are fastened to these rings.**

A wooden partition separates one stall from the next; and there is **a long water-trough running the whole length of the fore-stall.** The trough is kept filled with water from a pump.



3. *Remind the children, in the next place, that it is only in the winter-time that the cows are kept tied up in these stalls.* During the greater part of the year they live in the meadows, and **feed upon the grass.** But while they are shut up here they cannot find their own food. Hence **the farmer has to feed them.**

What does he give them to eat instead of grass? **He gives them hay.**

Point out that it is for this very purpose that the farmer makes hay, and stores it up in great ricks in the rick-yard.

He wants hay to feed his cows and horses, **when they cannot get grass** for themselves in the meadows.

Where do the farmer's men put the hay for the horses? They put it **in the hay-rack** over the manger.

Why? Because **the horse is very dainty over his food.** He would not eat dirty hay.

Lead the children to discover for themselves that in this cow-house **there is neither manger nor hay-rack.** *Then point to the heap of hay on the floor near the head of the stall.*

Tell that **the hay is thrown down on the floor,** *in the space between the drinking-trough and the wooden posts to which the cows are tied.*

The horse would not eat it, if it were thrown down there, **but the cow is not so particular about her food.** Hence there is **no need for a hay-rack** in the cow-house.

Next call attention to the **feeding-tubs,** *and explain that the farmer gives his cows* **oil-cake, meal,** *and* **cut swedes** *and* **mangels,** *as well as hay.* This part of their food is always put into these feeding-tubs, which serve instead of a manger.

II. Cow-house compared with Stable

1. *Turn once more to the water-trough. Remind the children that there is* **no water-trough in the stable.**

The cow can drink whenever it likes; **the horse drinks only when water is taken to it.**

Refer to the cattle in the fields. **Cows are often found in the watering; horses seldom.**

What does this show? It shows that **cows require more water than horses.**

Connect these facts with the uses of the two animals. The **cow is kept for milking,** the horse for work.

2. Now do you notice any other difference between the cow-house and the stable?

Call attention to the floor while this question is asked. The children will see that **this house has a wooden floor;** *the floor of the stable is paved with stone.*

The horse does not sleep on the stone floor; he has a **straw bed** to lie on. But there is **no straw in these stalls.**

Why not give the cow a straw bed?

Point out that **the cow lies down more than the horse does;** *the straw would* get dirty, *and want changing very often, and so more straw would be required than the farmer could spare.*

But the cow must be kept warm; **hence a wooden floor is used instead of stone.**

3. *This should be carefully explained. The reason is that in this part of the country* **little or no corn is grown.** *Hence* **straw is very scarce.** *The farmer could not afford to give his cows straw for a bed.*

N.B.—*In the class lesson, which is to follow this, the teacher would of course lay special stress on the free and abundant use of straw on those farms by way of contrast, and lead the children to point out the reason for the difference.*

4. Look round the building now, and see if you can find another difference? This building is open, but the stable is more like a house.

Refer to the stable-door or window. It is open only to let in fresh air.

Why then have an open cow-house? Because **the cow must have plenty of fresh air.**

Explain that the milk would be spoilt, if the cow could not get fresh air.

When do cows give most milk? In the warm summer weather.

When are they tied up in these houses? In the winter.

Why? **To keep them warm.**

5. *Other reasons may with truth be given, and are worth remembering:—*

(*a*) It is **easier to feed them in the houses,** as they must be fed with hay and roots in the winter.

(b) Cattle **pound or tread out the grass in a wet winter**, and so they would prevent it from growing again.

Refer to a well-known fact which at least some of the class already know. Cows always give **less milk after a cold night**; and the supply is less when they are **first turned out** in the early spring.

In this way lead to the point that **warmth is wanted to enable the cow to give plenty of milk.** The farmer takes care that they are kept warm.

Refer in this connection to the position of the cow-house.

It is well sheltered by other buildings, by the ricks, or by a wall. **Cold winds cannot enter it.**

III. The Calf-house

1. What do we call the young of the cow? A calf. (*Plural, calves.*)

What does the farmer do with them? He **keeps some** of them **for stock; the rest are killed** for food.

Pass round now to the calf-house. Open the door quietly, and take the children in, for probably the calves are there.

Notice the form of this house.

A raised wooden floor or stage, sloping slightly, runs along the wall. In front are upright bars of wood, some of which are easily taken out. The calves are fastened or tied up close to a fixed bar.

Every boy knows that they are put in this place **to be fatted for the butcher.** *All the calves are not put on this stage.*

Why are these kept here?

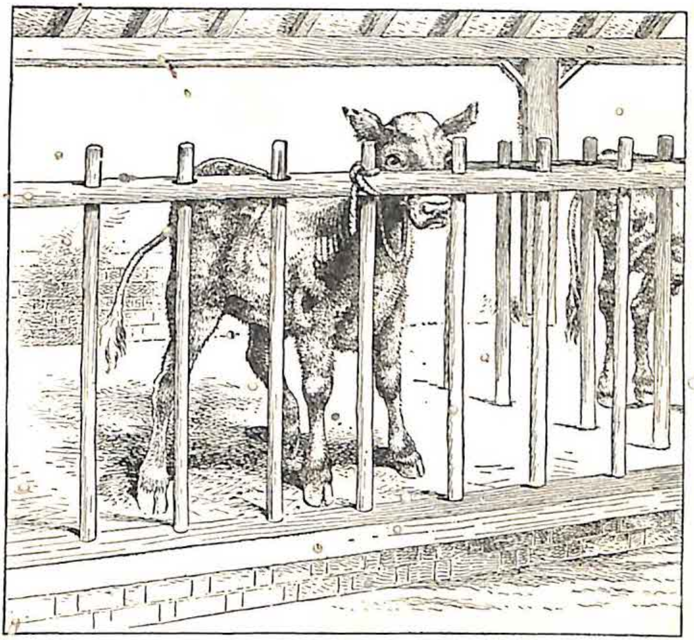
2. *Refer to baby at home. It is fat and chubby—mother takes great care of it. But a time comes when baby begins to lose some of its fatness.*

When is that? When it begins to run about.

What would these young calves do, if they were left to themselves? They would run and frisk about, and then they would not get fat.

The farmer then **keeps the calves tied up here,** because he wants them to get fat.

He places them on this wooden stage **to keep them from the damp earth.** They must be kept dry and warm.



Who can tell me what food the farmer gives the calves?

The children will readily tell that **the young calves live on milk.** *The men bring milk to them from time to time.*

IV. The Weaning-house

1. But we said just now that the farmer does not keep all his calves in this house.

Let us see if we can find any more.

Lead the way into the **weaning-house.** *Tell its name. Notice that there are many more calves in this house, and that* **they are not tied up.** *They can run and jump about as they please.*

2. *By comparing this with what was seen in the other house, it will be easy to deduce that* these are not tied up, **because the farmer does not want to fatten them.**

He wants them to grow big and strong. **They grow big and strong by running about.**

How does he feed them? He gives them warmed milk. Sometimes he makes a sort of tea from hay—**hay-tea** he calls it—and puts this with the milk.

By and by, when they are strong enough, he will turn them out into the fields.

What will they have to eat then? They will then be able **to eat grass like their mothers.**

Summary of the Lesson

1. The cows are kept in the cow-house all the winter.

2. There are stalls in the cow-house. Each stall has room for two cows.

3. There is no manger or hay-rack. The hay is put on the ground; the other food in tubs.

4. There is a water-trough. It is kept full of water.

5. The stalls have a wooden floor. Cows do not get a straw bed.

6. The cow-house must be open; the cows must have plenty of fresh air.

Lesson XIV (b)

THE FOLD-YARD

The sketch (on page 58) *is* a **rough plan of Temple Bruer Farm,** *near Grantham, Lincolnshire, which, together* *with several others in that district, was* **recently visited by the author** *in connection with this work.*

It is a large **arable farm** *with very little pasture land. Hence* **cows are not kept for dairy purposes,** *and there are* **no cow-houses** *properly so called.*

The teacher in such a district would of course take his children to see this class of farm, and afterwards compare and contrast it in school with the one described in Lesson XIVa.

I. KIND OF BUILDING

1. *Among the first attractions for the children on entering the farm-yard would naturally be* **the row of large square enclosures,** *sometimes on one side of the yard only, sometimes on both.*

These are commonly known as the **Fold-yards**; but in Lincolnshire and the North they are also called **Crew-yards.**

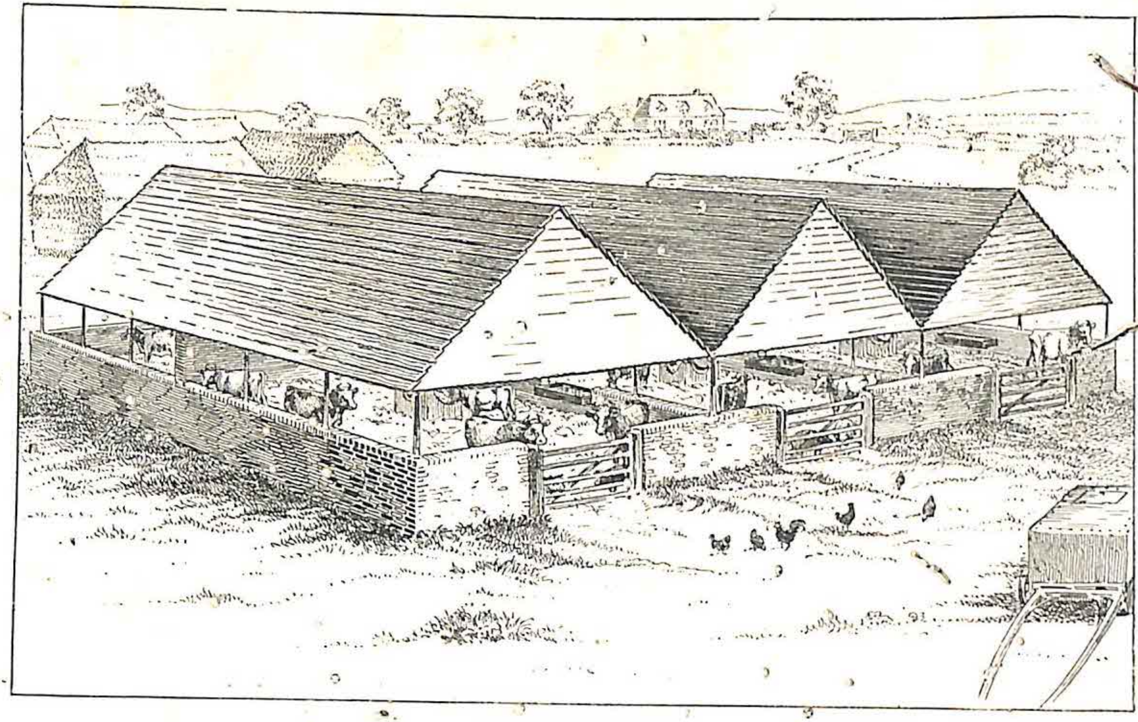
Lead the children up to the great gate, which opens into one of them. Notice that the place is **full of animals**—*not only cattle but sometimes pigs as well.*

2. *Explain the meaning of the name :*—It is called the Fold-yard, because the **animals are enclosed or folded in it**; it is also known as the crew-yard, because they **live together there** as a crew or a happy family.

3. *Notice next the enclosure itself.* It is surrounded by a wall about five feet high, and is **sometimes roofed** in, **sometimes left open** to the air.

The crew-yards at Temple Bruer are open above, but those of several neighbouring farms are covered with a roof. **The roofed yards are considered best in every way.**

In the **open yards** there is always a **lean-to shelter** running along one of the walls, where the cattle may get under cover in bad weather.



COVERED FOLD-YARD.

II. CATTLE NOT TIED UP

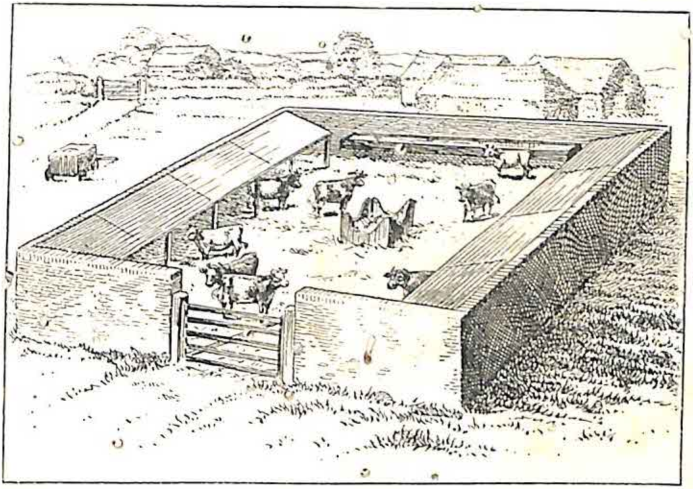
1. *The children have already noticed, of course, that the cattle in these houses are not tied up in one place, as the horses are in their stalls in the stable.*

Some of them are **moving about**, some are **lying down**, and some are **feeding**; but they are all **free to go wherever they please** in the crew-yard.

2. *Notice, too, how thickly the yard is* **littered with straw** *everywhere.*

Lead the children to tell what this straw is, and where it comes from.

It is the stalk of the corn. The farmer grows plenty of corn on his land. He has **abundance of straw** for all his purposes. He gives his horses straw for their beds, and he throws down **straw as litter for the cattle in these fold-yards.**



AN OPEN FOLD-YARD.

Explain that in many parts of the country the open or uncovered fold-yard, with its thick deep litter of straw, is known as the **straw-yard.**

3. *Notice in the next place how* **the feet of the animals sink in** *at every step as they move across the fold-yard. Explain the meaning of this :—*

When the cattle were first put into this yard, **the floor was well littered down with straw,** but after a time the straw became covered thick and deep with the **dung from the animals.** Then **more straw was thrown down,** only to be again **covered up with dung** as before. So it will go on till the cattle are removed and the place has to be cleaned out.

4. *Tell that the animals in these yards do the farmer an immense service,* **by treading out** *and* **breaking up this straw in the dung** *as they move about. The* **straw and the dung together** *make* **a most valuable manure for the land.**

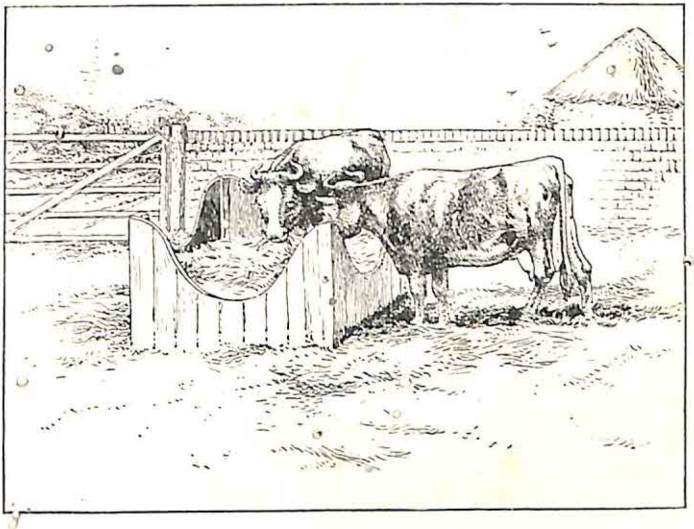
Notice too that the place (especially in the covered yards) does not get sloppy, for **all the liquid is carried away along a gutter** *into a great tank placed on purpose to receive it.* **This too makes valuable manure.**

In the class lesson on the cow-houses of the pasture farm (Lesson XIVa), which is to follow this, the teacher would of course make **the abundance of straw** *on the one hand and* **the scarcity of it on the other** *the chief point of contrast.*

N.B.—*As a matter of fact, the lack of straw is not felt on those pasture farms, so far as the manure is concerned, for* **straw would be of little service on grass land,** *as it could not return to the soil what had been taken out of it. This, however, is no part of our present scope. It is advisable to leave the matter at present, as it will be referred to again in a later stage in connection with manure.*

III. Food and Water

1. *Call attention in the next place to the* **great feeding-tub** *that stands in the middle of the fold-yard, and then to the* **long stone trough** *which runs the whole length of the yard on one side.*



THE FEEDING CRIB—OR TUMBREL.

The tub is commonly known as **the crib**; but in Lincolnshire it is more often called a **tumbrel.**

The food for the cattle is placed in the **crib** or **tumbrel,** and also in the **trough.**

2. *Let the children take some of this food in their hands, and examine it for themselves.*

It consists of **chaff** (that is, **chopped hay**) and **mangels** or **swedes,** also cut up small.

The farmer also gives his cattle **oil-cake, meal,** and **cow-cabbage** as a change of food.

Explain that this food is cut up and prepared in one of the **food-houses,** *and carried to the tumbrel or crib in* **large wicker baskets.**

3. *Notice the* **drinking troughs** *now.*

In some houses these are **placed in the party wall between two fold-yards,** so that the animals on either side may use the same trough.

In others they are placed **partly in and partly out of the loose-box** or stall which stands in one corner of the fold-yard. *(See Plan of Temple Bruer Farm.)*

The animal in the stall and those in the yard can always drink when they wish. The trough is kept filled with water from a pump.

IV. CATTLE REARED FOR STOCK

1. *Children are so accustomed everywhere to think of the cow as the animal which supplies us with milk, that it cannot fail to be a surprise to them to learn that, in these yards and sheds,* **the cattle are not kept for milking purposes.** *Tell that all the cattle in these yards are being* **reared and fed for the market.**

When they are in a fit condition **the farmer will sell them to the butcher.**

2. *In looking through the various yards, the children will see that the animals in one enclosure look bigger and older than those in another.*

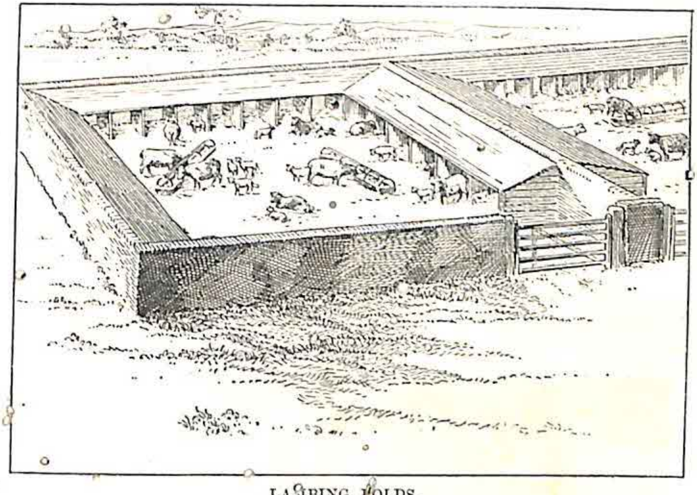
The farmer usually keeps those that are as nearly as possible the same age **in the same enclosure.** They live and feed and grow together.

3. **The young calves, which are meant for stock,** are put all together in one of the fold-yards. But those which are to be **fatted for the butcher** are placed one or two together **in small enclosures,** where they have no room to run about.

4. *In the* **Park Farm, Kirtlington, Oxfordshire,** *which was* **recently visited by the author,** *these small calf-houses are placed side by side* **on a sort of raised platform between two fold-yards.**

V. SHEEP-FOLDS

In the **Temple Bruer Farm,** *of which a rough plan is given (on p. 58), there are some* **large open yards,** *known as the* **Sheep-folds,** *or* **Lambing-folds.** *Lincolnshire is a* **famous sheep-breeding district.**



LAMBING FOLDS.

In this, and all such parts of the country, similar sheep-folds will be found in every farm-yard, and they would be **especially interesting to the children at this time of the year—the lambing season.**

The yard is well **littered with straw,** *and* **shelters** *are arranged* **round the walls** *for the ewes and their lambs.*

SUMMARY OF THE LESSON

1. The Fold-yard is a large square yard in which cattle are kept.

2. It is sometimes called the Crew-yard, and the Straw-yard.

3. It is sometimes roofed in, sometimes open.

4. The floor is covered with straw; the cattle are not tied up.

5. The great feeding-tub in the middle of the yard is called the crib, or tumbrel.

6. The cattle are reared in these yards for the market.

7. Some farm-yards have sheep-folds where the little lambs are born.

Lesson XV

THE PIGGERY

I. The Pig-sty

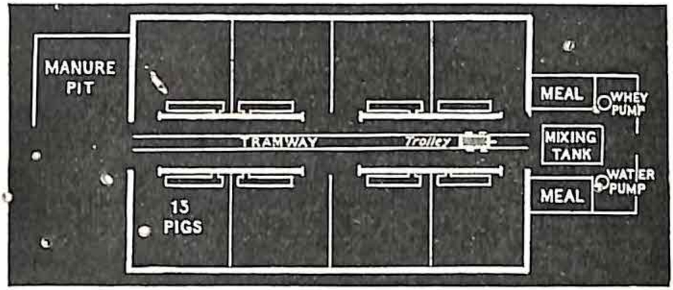
The next visit should be to the piggery, and of course it will be found at the rear of the other farm-buildings. It is always an important part of the arrangement in every farm-yard.

1. *Notice the form of the buildings.*

There is a **low shed-like shelter with a wooden floor** which serves for the bed. Outside this there is a **small bricked fore-court,** with a gutter running down the middle of it. In this little yard there is a **feeding trough,** and there is usually a little door through which the food is passed into the trough.

Should there be a large piggery on the farm, the above will answer for each sty in it. But sometimes all are under one roof, and then there is no real division between the bed and the fore-court, except perhaps the gutter.

2. *In some large piggeries there is* **a sort of tramway** *with a trolley running through the house, for the purpose of carrying the food for each sty. There are also, as a rule,* **two**



pumps—*one for water, and one for whey and buttermilk, which are run through a pipe from the dairy to* **a large tank in the ground,** *and pumped up as they are wanted.*

In most cases too there is a **meal-house,** *and* **a large tank in which to mix up the food.**

II. Pigs are not tied up

Why are pigs kept in a small sty? To make them fat.

Refer to the calves in the calf-house and the weaning-house.

What did we learn from them? We learned that animals allowed to run about do not get fat.

Why then are the pigs not tied up?

Show the difficulty of doing this (*a*) **from the build of the animal;** (*b*) **from its stubborn, obstinate nature.**

What does the pig do as soon as it has eaten all it can? It lies down, and is quiet and content. **There is no need to tie up a pig.** It is kept in a small sty, so that it may not have room to run and jump about.

III. Food for the Pigs

1. *Examine the food in one of the hog-tubs, and compare it with the food of a horse or a cow.*

The pig's food is well mixed with water or whey, and is **sloppy.** It is almost all liquid, like the food of the calf. Horses and cows have solid food. Why should the pig's food be sloppy?

An answer to this question may be obtained by reference to many points in the previous lesson, which show that everything is done to further the end in view.

2. The object of the feeding is **to fatten the pigs.** This sloppy food is found **best for a lazy animal like the pig,** which does nothing but feed and sleep. It helps to fatten the animal.

What is this sloppy food made of? It is made of **barley-meal** or **pea-meal,** together with a little **Indian-corn meal,** and it is sometimes **mixed with water,** but more often with **buttermilk** or **whey** from the dairy.

Needless to observe, the children in most parts of the country are quite familiar with whey and buttermilk—they know what both the liquids are, and whence they are obtained.

3. Why do you think the animals are fed on meal? Because it fattens them quickly. It is the best food for fattening pigs.

Refer to the usefulness of milk as food. Tell that whey and buttermilk, which are part of the milk itself, not only help to fatten the pigs, but also make them grow big and strong. They make flesh. The farmer wants his pigs to be **fleshy as well as fat.**

Promise to explain more about this in a later lesson.

IV. POSITION OF THE PIGGERY

Question the children about the sty itself.

It is cleaned out once a day; the gutter keeps it dry.

Suppose it were not cleaned out? It would get **very filthy,** and **smell very bad.** It smells even now.

Try whether the class can tell that bad smells and dirt are **not only unpleasant but unhealthy.** *If they cannot do so, the teacher must tell them.*

Why then is the pig-sty often cleaned out? Because it is better for the pig. Even the pig must be kept **as clean as possible,** if it is to be healthy.

Refer to the manure-heap in the cow-house, and so lead the children again to tell that the pig-sty, like the manure-heap, is kept far away from the farm-house, **so that the wind may not carry the bad smell** to the people who live there. It would make them ill.

SUMMARY OF THE LESSON

1. Pigs are kept in a small house called a sty.

2. Pigs are not tied up; but they have only a small yard. They cannot run about very far.

3. The farmer wants his pigs to grow fat quickly. He feeds them with sloppy food or swill.

4. Pigs smell very bad. Their houses are always placed a long way from the farm-house.

5. The pig-sty should be often cleaned out. The pigs cannot be healthy in a dirty house.

Lesson XVI

THE HAY-BARTON

I. INTRODUCTION

1. *WINTER will be a good time for a visit to this part of the farm-yard, because at this season one or more of the stacks will be in cut, and probably much reduced. Under these conditions it will be possible to examine the hay in the middle of the stack.*

On the way lead the children to chat about the hay-making in the summer-time, the use of hay as fodder for the cattle, the manner in which the farmer stores it in great stacks till it is wanted for use, and so on.

2. *Tell them that* we are now going to pay a visit to that part of the farm-yard, where the farmer stacks not only

his hay, but also his corn. He calls it the **rick-yard**; but the part of it where the hay stacks stand is sometimes called the **hay-barton**.[1] We will visit this part first.

On many farms, and in the same barton, some of the hay is stacked in **hay-sheds** *and some in* **ricks**, *simply according to space. This is probably the case in the barton which is now being visited. If so, call attention to the fact, and proceed :—*

II. THE HAY-SHED

Let the children walk round it and examine it.

It is simply **a roof supported upon strong, high poles** firmly fixed in the ground. Stout battens, stretching from one pole to the next, are strongly bolted to the tops of these uprights, and so keep them in their place.

The roof is of **corrugated iron**, and is rounded to throw off the rain-water. A shoot runs along the eaves of the roof, and on each side a spout leads down one of the poles from this shoot into a barrel.

Call the attention of the children to all this, and the inference is clear, that the farmer's aim is **to keep his hay dry**. Rain would ruin it.

III. THE HAY-RICK

1. *Pass on to examine the ricks next. Point out that* some of the ricks are **round**, others **oblong**. *Tell that this all depends upon the amount of space there is to spare.* They are **thatched with haulm**, or **straw**, or **reeds**. The thatch is held firmly in place by **split U-shaped spars of willow** or **withy wood** driven into the hay.

Notice that the thatch slopes like the roof of a house; and elicit the reason for this.

2. *Notice too that :—*

(*a*) *The under part of each stack is cut away near the ground, so that* **the bottom slopes inwards.**

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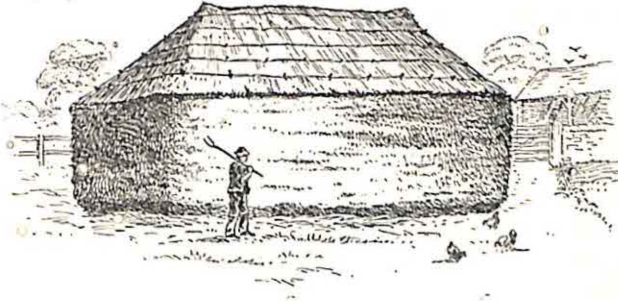
[1] The name is common in the West of England.

(*b*) *The stacks stand either upon a* **bed of straw-litter,** *or on* **dry branches of trees** *(called brach).*

This bed is known as the **staddle.**



The neat, tidy, upright sides of the ricks should also be noted. This is brought about by raking and hand-pulling while the rick is being made. Most of the boys will no doubt have seen something of it.

3. Lastly, call upon one of the boys to thrust his hand into the hay from the outside. He reports that he cannot do it. Explain that this is because **the hay is pressed together very tight.**

It will be an easy matter to elicit from the children that the closeness of this part of the rick is due to the weight of the hay above.

But in every part of the rick the hay is packed quite as close. How do you account for that?

Some of the boys have probably been on a rick while it is being made. They will of course remember the farmer's amusing promise to give sixpence to the boy who can show the print of his boot-nails in the hay.

Explain the little joke now. The farmer wanted the boys to jump as hard as they could on the hay, **in order to press it down well.** Their boot-nails would not leave any marks on the hay though, however hard they might jump.

Where does he like it pounded most? Round the sides.

Tell that the farmer himself, or a trusted farm-hand, does this. It is called **making the rick** and must be done carefully.

IV. PROPERTIES OF HAY

1. *Take a handful of hay from the outside, and another from the inside of the rick. Put a little of each into separate basins, fill up with hot water, and stand aside for a while.*

Contrive, with the help of one of the farm-hands, to get **some of the meadow flower** *in the bunch from the middle, and proceed to examine the two specimens.*

That from the outside is **very dry, brittle, and hard.** It is of **a straw colour,** and has **not much smell.**

The middle hay is **soft,** has **a greenish, grass-like appearance,** is **full of seeds,** and has **a sweet smell.** The flower looks almost as fresh as when it was first cut.

2. *Compare this with a cut flower from the garden.* The flower dries up and withers after a time.

What dries it up? The air.

What causes it to wither? The sun.

Why then has this flower of the hay kept so fresh? **The sun and the air have not been able to get to it.**

Why not? Because it was in the middle of the rick.

3. *Call attention in the next place to the two basins. The liquor in them is* **not clear water now.** *It is coloured* **something like tea.** *The hot water has soaked out the goodness of the hay, just as the hot water soaks out the goodness of the tea, which mother puts into the tea-pot. Notice too that the liquor in one basin is darker than that in the other.*

Tell that the farmer calls this **hay-tea.** *He makes* hay-tea to mix with the milk for the young calves. **He gives them the liquor to drink,** *but he throws the leaves away, just as mother throws away the leaves out of the tea-pot.*

The hot water soaks out the juice of the hay. **This juice is the real goodness of the hay.**

4. Suppose this were real tea in these basins. What would mother say about them? She would say the dark-coloured tea is better and stronger than the other.

Tell that the farmer says just the same about his hay-tea.

This **dark-coloured hay-tea** was made from hay from the **middle of the rick**; the other was made from the outside hay.

What have we learned from this? We have learned that the **hay from the middle of a rick is richer and better** than that on the outside. It makes better hay-tea.

How else can we tell the difference? We can tell it by its **colour, smell,** and **softness.**

Point out that the hay was all the same when it was first put in the rick. **It has changed since.**

5. *Sometimes in cutting a rick a dark streak is exposed. Should this be seen in the rick under examination, the teacher will have a good illustration of the ill-effects of letting in the rain. The hay in the dark streak will be partly rotten or mouldy, and unfit for use.*

Now what are the things the farmer must keep from the hay? The air, the sun, and the rain.

How does he do this? By **pressing** or **pounding the hay well** while the rick is being made, by **cutting it out** and **trimming it,** and by providing **a good staddle and thatch.**

N.B.—*There is a common error in the country that the hay is pounded well to make it cut more easily. But this is only an attendant circumstance of the true reason.*

SUMMARY OF THE LESSON

1. Hay is stacked in hay-sheds and ricks.
2. The hay must be kept dry. Rain would spoil it.
3. In making the rick the hay must be pressed down well.
4. The best hay comes from the middle of the rick.
5. Good hay is green, full of seeds, sweet to smell.

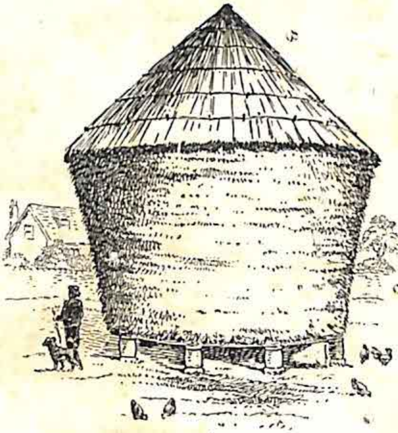
NORMAL
OOGHLY
CHOOL.

Lesson XVII

THE FARMER'S CORN

I. THE CORN-RICKS

1. *Pass on now to examine the corn-ricks, comparing them with the hay-stacks close by.*



Point out that they are alike in shape and thatch, but differ at the bottom. The corn-rick **stands upon short round pillars**, to raise it from the ground.

Ask a boy to get an ear of corn out of the rick. He has to pull out a straw. **The corn is in the middle;** *the straw is turned outwards.*

Refer to the hay-rick. The middle was soft—even the seed of the hay was soft.

Examine the corn. **The grains are hard and dry.** Why is this?

2. *Call attention to the straw.* The **stalk is really a**

hollow tube. Blow through it, and you will feel the air coming out of the other end.

The outside of the straw is **hard** and **shiny, smooth** and **dry.** *Put the straw in hot water now, and leave it.*

3. *Tell that in making the rick the farmer does not press and pound it as close as he does the hay-rick.* The sheaves of corn are laid in order, with the ears in the middle, and the straw on the outside.

What then can happen while the rick stands in the yard? The air can easily pass through the straws to the middle of the rick. **The air makes the corn dry and hard.**

4. *Point out that, by standing the rick on those short, round pillars, the farmer leaves* **an open space beneath it,** *and so* **the air can also pass up through the middle of it.**

Notice too that this serves to **keep the corn off the damp ground,** *and also to keep rats and mice out of the rick.*

Lead the children to discover another reason for placing the ears in the middle of the rick. **It prevents the birds from carrying off the corn.**

5. *Examine the straw that has been lying in the water now, and compare it with the hay that was similarly treated.* **The straw is not softened; the water is not changed.** Directly we take it out, the water falls off, leaving the straw nearly dry.

Dip two sticks in water—one roughly cut, the other highly polished. Let the children observe that the water quickly rolls off the smooth one, leaving it dry, but soaks into the other. Compare the polished stick with the smooth shiny straw.

Water readily runs off straw, because it has a smooth, shiny surface. That is why it is **used for thatching.**

6. We noticed something else about the straw just now. The water in the basin was not changed. There was no juice in the straw to be soaked out.

What does that tell us? It tells us that **straw is not useful as food for animals.**

What does the farmer do with the straw? He uses it to make **bedding for them,** and then puts it on the land for **manure.**

II. THRESHING THE RICK

What must be done before he can get the straw? The **rick must be threshed.**

It is more than likely that the farmer has been, or will be, busy about this time with the work of threshing.

While it is neither necessary nor desirable at this stage to go into the structure and working of the threshing-machine, the children should, if possible, see it at work.

The object of the machine is to **separate the grain from the ear.**

They will see for themselves that, as the work goes on, **the grain falls into a sack placed to receive it,** *while* **the straw is stacked in a rick** *again, to be taken out as it is wanted.*

III. THE BARN OR GRANARY

1. But what will the farmer do with the grain in those sacks? He will put them in the granary.

The children have already had a peep into this building. Let them tell what they remember about it, and then take them to see it as it is now.

The first thing they observe is **the great heap of corn** *on the floor, and probably they will find one of the farm-hands at work shovelling the corn about with a great broad wooden shovel.*

2. *Let one of the boys thrust his hand deep into the heap of corn, and keep it there for a few moments. He will tell that* **the corn feels quite warm.**

Now let him place his hand on the top of the heap. It is not warm there.

Notice that the man is very careful **to thoroughly turn the corn over.**

Why is this? The farmer **does not want his corn to get warm**; the man turns it over from time to time, to bring the warm corn from underneath to the top, so that it may cool.

3. *Lead the children to tell, from what they have already learned, that the two things necessary to make seeds grow are* **warmth and moisture.**

These grains of corn would sprout and grow, if they were put in a warm damp place. But **the farmer does not want them to grow.** Hence he puts the corn on this dry wooden floor, and the man keeps it turned over from time to time to prevent it from getting warm.

4. *Point out too that plants want light, as well as warmth and moisture, to make them grow.*

When we put seeds in the ground in the spring, they sprout and grow in the warm moist soil, because **they are trying to force their way up to the light.** Plants cannot live, seeds cannot grow in the dark.

Now, what did we notice about the granary? It is quite dark, when the door is shut, for **it has no windows to let in light.**

The farmer not only **keeps his corn dry,** and **prevents it from getting warm,** but he also shuts out the light—and **all this is to prevent the grains from sprouting and growing.**

What will he do with all this corn in the granary? He will **send it to the miller to be ground into flour.**

Summary of the Lesson

1. Corn, like hay, is stacked in a rick in the rick-yard.
2. A corn-rick stands upon short round pillars; a hay-rick has a staddle.
3. The ears are placed in the middle; the straw outside.
4. The air passes through the rick and makes the corn dry and hard.
5. When the corn has been threshed it is stored in the barn.

Lesson XVIII

THE MILLER AND HIS WORK

Provide for illustration—some grains of wheat, and specimens of the different varieties of meal which come from the grain. Brown's picture of the interior of the mill, with details of the mill-stones, and the dressing machine, and other pictures of the windmill and the watermill should be shown.

I. INTRODUCTION

SHOW some grains of wheat. The children of course will be at once reminded of the heaps of grain they saw in the granary at the farm.

What does the farmer do with all that wheat? He sends it away to the miller.

What does the miller do with it? He grinds it into flour for making bread.

Hand round some flour in a saucer, and let the children take some of it in their hands and examine it. Lead them to tell that it is **a very fine powder,** like white dust; that **it sticks to their hands**; and that if they rub it between their fingers **it feels very soft and smooth.**

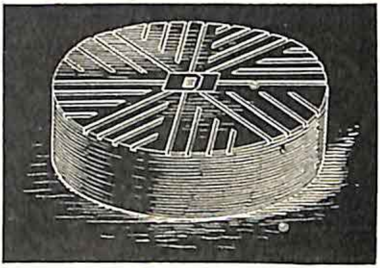
Let us find out now how the miller changes the grains of wheat into this fine, soft, smooth powder, which we call flour.

II. GRINDING THE CORN

1. In the mill the work of grinding is done by **two great millstones.** These are round and flat, and are placed with their flat sides one above the other, just as I might place these two pennies. When the mill is at work **the upper stone moves round and round** very rapidly.

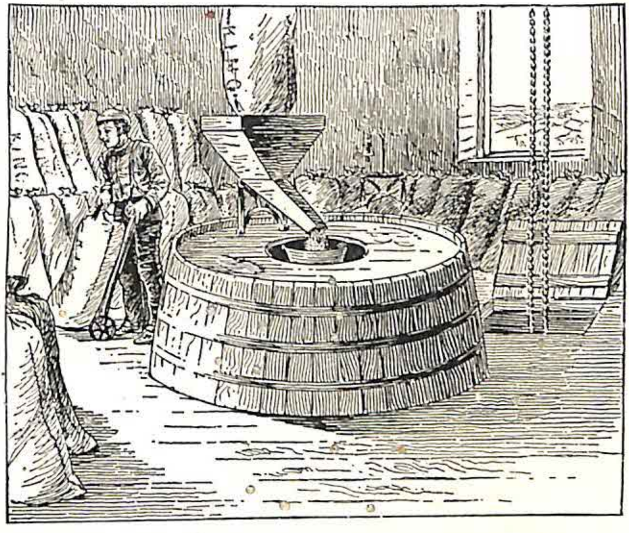
So rapidly does this great mill-stone whirl round and round that it would be impossible for the eye to follow it.

Make a black-board sketch of one of the stones, and call *attention to the* **grooves** *cut in its surface. Tell that* **the sharp edges of these grooves cut up and grind the corn to powder,** *as the top stone moves round on the under one.*



2. The grains of wheat are poured, a few at a time, through a hole in the top stone, as it whirls round, and the whirling movement carries them between the two to be ground up.

Show a picture of the interior of the mill. Call attention



to the **hopper,** *a sort of funnel-shaped box placed exactly over the hole in the top stone. The wheat is first run into the hopper from a sack, and from the bottom of this funnel it drops, little by little, between the grinding-stones as it is wanted.*

3. *Point out that the stones themselves are* **boxed in with a wooden casing,** *to prevent the flour from being scattered about and wasted. Explain, too, that the draught of air, caused by the rapid whirl of the stone,* **blows out the flour** *as quickly as it is ground, so that the millstones never get clogged.*

Excite the curiosity of the children next by reminding them that this great millstone is very heavy. A man—even a very strong man—would not be able to keep it moving, and yet it has to spin round very rapidly indeed. Let us see how this is done.

III. DIFFERENT KINDS OF MILLS

1. THE WINDMILL.—*All the children are of course familiar with the windmill. They have watched the great sails swinging*

round; they know it is the wind that sends them round. Explain now the object of these great moving sails.

The wind blows against them and drives them round, and as they swing round on the outside, **they move the stone itself inside the mill.** But it is the wind that does it all. That is why we call this mill a **windmill.**

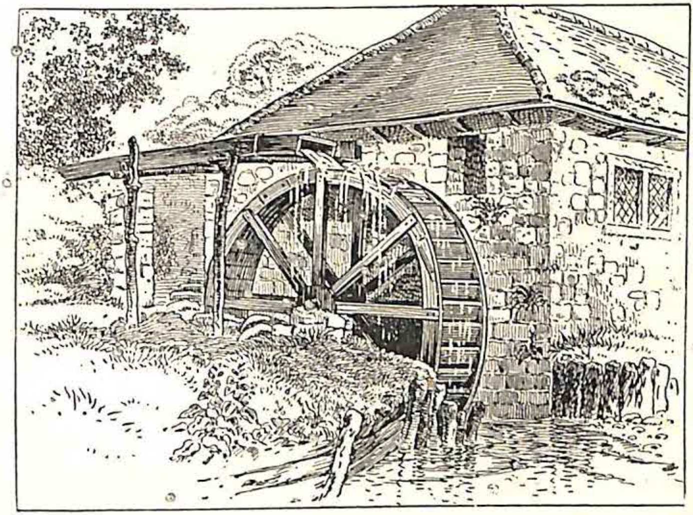
Elicit from the children that windmills are always placed in the open part of the country—usually on a hill.

Why not in a low-lying valley? Because the sails would not catch the breeze there.

What happens when there is no wind? The sails hang still.

What does that mean? It means that the work in the mill is stopped. **If the sails are still, the millstone is still too.**

2. THE WATER-MILL.—*Ask the children whether they know*



of any other sort of mill. There is most likely a water-mill close by. Lead them to talk about it, and especially about its *chief feature*—**the great wheel on the outside.** *The teacher of course is familiar with the mill in question. It may have an* **overshot** *or an* **undershot wheel,** *and his description must vary accordingly. In either case the working of the wheel, and the* **purpose of the mill-dam,** *to keep up a constant head of water, would be best explained in the course of one of the out-door rambles. If that were done, it would be an easy matter to elicit the facts from the children themselves now in class.*

It is the force of the running stream which moves this great wheel. **Water,** not wind, **does the work** in this case. Hence we call this a **water-mill.**

Point out that when once the wheel on the outside is set in motion, it sends the millstone inside the mill whirling round, and so the work of grinding the corn can go on.

What must happen to such a mill **in the dry summer weather,** when there is very little water in the stream?

What again must happen **in the winter** when the stream is frozen over?

3. THE STEAM-MILL.—*Tell that most mills are now worked by steam. The great steam-engines work on, night and day without stopping, as long as they are wanted.*

These mills are better than either wind-mills or water-mills. Why?

IV. DRESSING THE MEAL

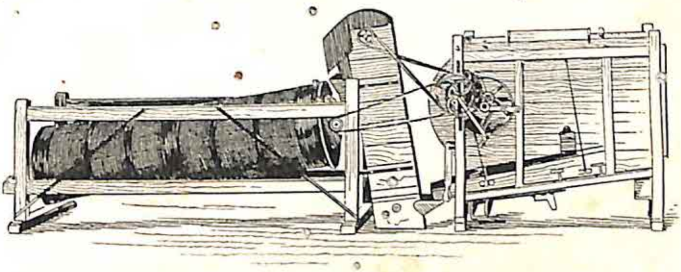
1. *Show specimens of* **whole-meal, fine whites, seconds** *or* **households, pollard,** *and* **bran.** *Explain that all these come from the grains of wheat. Leave the names for the present.*

The ground wheat, which falls away from the millstones, is not flour like this in the saucer. It is coarse, brown-looking stuff like that which I showed you just now. The miller calls it **meal,** and because it contains the whole of the grain he also calls it **whole-meal.** Take some of it in your hand, and see if you can tell me the difference between it and the fine white flour.

Lead the children in this way to pick out the **coarse scaly particles** *of the meal. They cannot find any of these in the white flour. That is very fine, soft, and smooth. Yet all flour was at first coarse like this meal.*

2. What would be a good way to get the fine flour from this coarse meal? We might **sift it.**

Well, that is exactly what the miller does. The most important part of his work begins when the millstones have ground up the grain into coarse meal like this. He calls it **dressing the meal,** and this dressing gives him different qualities of flour, such as **finest whites, seconds** or **households,** and a third or coarser kind still, known as **tailings.** The coarse, brown, scaly particles are separated out from the flour by this sifting, and are called **pollard** and **bran.** **Bran is the coarsest part of all.**



Show the specimens as they are described, and lastly proceed to examine the pollard and bran.

Lead the children, by their own observation of the specimens, side by side with the grain itself, to the conclusion that these coarse, brown, flat particles of **pollard** *and* **bran** *must be* **pieces of the outside skin of the wheat.** *Tell the difference between the two.*

3. *Describe briefly* **the dressing machine.** *It is a sort of* **long barrel,** *covered with* **gauze.** *The first, or upper part of it, is a* **very fine gauze made of silk**; *the rest is made*

of **wire,** *with coarser and coarser meshes towards the lower part.*

A long **spindle-brush** *runs through the middle of the barrel from end to end, and the barrel itself is placed* **in a slanting position.** *Both barrel and brush are made to* **revolve very fast.**

4. *When the meal is poured in at the top, the revolving brush sweeps it through the meshes of the sieve. Only the* **finest flour falls through first.** Why?

This is caught in a large bin placed below, and then the **seconds** *or* **households** *follow through the coarser meshes which come next. The* **tailings** *fall through a still coarser part lower down; the* **pollard** *goes next; and so at the lowest end nothing is left but the* **bran.**

5. *Close the lesson by eliciting from the class the various uses to which these products of the grain are put.*

Most of our bread is made of seconds or households flour. **This makes better bread than the very fine flour.**

Whole-meal bread is made of the meal just as it leaves the millstones. It is not sifted; **it makes brown bread.** This is very good to eat.

The very finest white flour is best for making pastry.

The children all know that the farmer uses bran and pollard for feeding his cattle, pigs, and poultry.

SUMMARY OF THE LESSON

1. Corn is ground into flour in a mill by the miller.

2. There are wind-mills, water-mills, and steam-mills.

3. The whole-meal which comes from the corn must be sifted or dressed.

4. It is sifted into fine whites, seconds, tailings, pollard, and bran.

LESSONS ON THE SEASONS

Lesson XIX

WINTER

Choose a typical day during a spell of hard frost in midwinter for the lesson, so that the children may have around them on every side all the phenomena, which are being dealt with by the teacher.

Some time during the morning prepare a freezing mixture with **equal quantities of crushed ice and salt**—*enough to fill a good-sized bowl. Then fill a glass flask with water, stand it in the bowl, and pile the freezing mixture close all round it.*

Let all this be prepared in the presence of the class, so that when the lesson comes they may remember what they saw teacher do. Say nothing whatever about it for the present, however. The water will take about ten or fifteen minutes to freeze.

I. Ice is Solid Water

1. Water Freezes with Cold.—*Commence by placing the bowl on the table before the class, and let them tell what they saw done with it.*

You saw me fill the flask with water. Let us take it out of the bowl now, and examine it.

The flask has most likely burst in the freezing. If so some of the ice will be seen protruding through the split. But if it is not already burst, break it and show the lump of solid ice inside exactly the shape of the vessel itself.

2. What has happened? The water in the flask is **no longer a liquid**. It will not flow about. It has changed into ice, and **ice is a solid.**

What has made it change? The cold mixture of ice and salt in the bowl.

Let one of the boys thrust his hand into the middle of the freezing mixture. He of course finds it very, very cold. He does not keep it there long.

Tell that liquid water always changes into solid water when it is very cold. We say the **water freezes,** and the **solid frozen water is called ice.**

3. *Lead the children to tell that the puddles of water in the roadway are now changed into ice, and that the ponds and ditches everywhere are covered with a thick sheet of ice—thick and strong enough to bear ever so many people on it skating and sliding.* **The cold has done it all.**

4. *Remind the children that if we stand a basin of water out of doors now for a very short time, we are sure to find it* **frozen into a lump** *of ice when we look for it.*

Lead them to tell how the wind seems to nip and bite their hands and faces as they run along to school.

The wind is only the moving air. The air itself is bitterly cold now. It is **the cold air that makes the water cold,** and when water gets very cold it freezes into solid ice.

5. *Call attention to the* **icicles** *hanging from the window-ledges and the trees. Tell that the air is so cold that this water* **changed into solid ice as it was falling,** *and so we find these long sharp spikes of ice hanging from the trees and ledges.*

II. FROST, SNOW, HAIL

1. THE EARTH FREEZES.—*Point out that although it is cold everywhere, boys and girls must not huddle round the fire all day. There is plenty of fun to be got out of a winter's day. A good brisk run, some sliding on the ice, and a tussle at snowballing, will really make them warmer than they could be by sitting over the fire.*

Suppose we put on our hats and coats now, and go for a run. It will do us good, and we shall be able to learn something as we go along.

2. *Set the children into a sharp trot and call attention to the* **ringing clatter of their feet** *on the ground as they run.*

Our feet do not always make this ringing sound as we run along. What does it mean?

Remind the children that the **earth is porous**—*full of holes or pores—and that the water which falls on the ground* **soaks into these pores.** *There is always water in the earth.*

3. This water in the pores of the earth, like all the rest of the water everywhere, is so cold now that **it has frozen,** and in freezing **it binds the particles of loose earth close together into a hard solid mass**—the earth itself is frozen hard; it is the hard frozen ground which makes that ringing sound as we run.

1. FROST.—*Call attention next to the* **white coating** *which sparkles on the* **branches and twigs of the trees,** *and on* **every ledge** *and* **wall.** *The trees look as if they had been sprinkled with glistening powdered white sugar from a pepper-box.* We call this **frost.** Let us see what it is.

Remind the children that there is always some **vapour in the air**—*that the air holds little drops of vapour in its pores, just as the earth holds little drops of water.*

2. The air is so cold now that the **vapour in it freezes,** and settles on everything in the shape of frost. *Let the children examine the little* **spikelets of frost** *for themselves.*

Remind them too of the **beautiful pictures they see on the window-panes,** *when they first look out in the morning. These are all the work of Jack Frost. They are formed of the* **frozen vapour in the air.**

1. SNOW.—*This thought will naturally lead the teacher to notice the clouds next.*

Elicit from the class that:—

(*a*) *The* **clouds are immense masses of vapour** *piled up heap upon heap in the sky.*

(*b*) *When the little particles of this vapour run together,* **they form drops of water.**

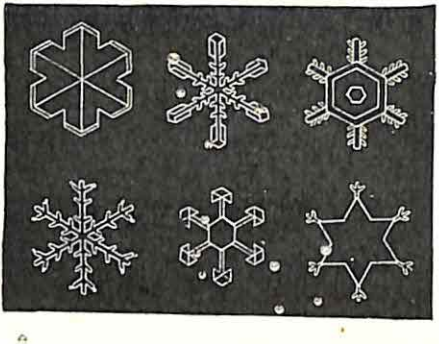
(c) *These drops of water, being heavier than the air,* **fall to the ground as rain.**

2. *Tell that when the air near the clouds is very cold indeed, the vapour in them does not change into drops of water.* It freezes at once, and this **frozen vapour falls to the ground as snow.**

The wind is probably in the north. Tell that the north wind is always a bitterly cold one, and remind the children of the lines :—

The north wind doth blow
And we shall have snow.

3. *Lead them to describe the* **loose, light, feathery snowflakes.** *Explain that in the clouds this water-vapour is* **mixed with air,** *and that when the vapour gets frozen,* **it is the air in it which gives the snow its white colour and loose feathery appearance.** *Show a drawing of the snow-flakes, as they appear under the microscope. Compare the falling snow with the falling rain.*



Notice too that the rain, as it falls, runs away along the ground; the **snow lies where it falls,** and covers the ground. Why? **Snow is not a liquid.**

What causes the snow to go away at last? **It melts into water;** water is a liquid and it flows away.

The struggling sun may by this time have had its effect on some *of the frosty ledges, and on some of the icicles hanging from the trees. If so call attention to this, and let it answer the question.*

HAIL.—*Lastly, tell that it is sometimes so cold up in the sky that* **the rain-drops freeze as they fall.** *They reach the ground, not as drops of water, but as little* **round balls of ice.** *We call them* **hail.**

At this time of the year, you see, we find **the water frozen,** the **earth frozen,** the **vapour of the air frozen,** the **clouds in the sky frozen,** and sometimes the **rain-drops,** as they fall from the clouds, **frozen.** It is all because the air around us is bitterly cold. We say **the weather is cold.**

What name do we give to this part of the year? We call it **winter.**

III. THE GARDENS IN WINTER

Put the children to another smart trot now to prevent them from feeling the cold, and when the trot has slowed down again into a walk, as of course it will, turn the conversation to the garden at home.

1. What is the garden like now? It is **quite bare;** there are **no flowers.**

What has become of them? They are dead; the **winter frost has killed them.**

Well, the winter frost has killed many of them. But the roots of others are still alive in the ground, although the tops have died down. By and by, when all the frost and cold are over, **new plants will grow up** from these roots. **Such plants are not dead; they are resting during the winter.**

2. *It would be well to take the first opportunity, after the return to school, of digging up some resting root or underground stem, for the children to examine.*

For the present lead them on to think about trees and bushes.

These do not die down to the ground. Their **hard woody stems stand all through the winter.**

Notice the condition of the trees, shrubs, and bushes everywhere. They are all bare. Their leaves are all gone. Even the clumps of bramble here and there are bare twigs and nothing else.

3. *As the walk continues endeavour to stumble accidentally across some* **ivy, laurel,** *or* **holly.**

What does this mean? These are **the only green plants** we have seen—they have green leaves all through the winter.

Tell that these plants are called **evergreens,** *because they are always green. The old leaves do not fall off* **until the new ones come.** *Say a word or two about Christmas decorations, and the red berries on the holly, and promise to deal more fully with these plants later on.*

IV. THE FARM IN WINTER

1. *Lead the children back by way of the farm. As they cross over the meadows, notice that there is* **not a single cow to be seen.**

Where are the cows now? They are **shut up in the cow-house** or **byre** at the farm. They are never left out in the open fields through the winter.

But what do we see in the next field? They are sheep. **Sheep live out of doors all through the year.**

Call attention to their full-grown fleeces. These **thick coats keep them from the cold,** *and the farmer's man fills their feeding-troughs with plenty of* corn *and cut swedes twice a day, so that they may have enough to eat. He also gives them some hay in the hay-rack which stands close by.*

2. *Turn off now into the* **ploughed fields.** *The soil is frozen hard.* There are **no crops growing here.**

What does the farmer do all this time? Are he and all his men idle through the winter?

The party may possibly meet some of the heavy lumbering **putts** *or manure carts* **laden with manure,** *and this will answer the question.*

During the winter, when the weather is not too severe, the farmer is busy **hauling or carting manure** to spread on the land to make his crops grow by and by.

Tell that besides this there is always plenty to do in and around the farm-yard itself. Lead the children to think of the animals that have to be **attended to, fed,** *and* **kept clean.**

What with all this, and the **milking** *and* **butter-making, the farm is a busy place even in the winter time.**

Summary of the Lesson

1. Cold changes water into solid ice. We say the water freezes.

2. When water freezes in the pores of the earth, the earth itself becomes frozen hard.

3. The vapour freezes in little spikes of frost.

4. The vapour in the clouds freezes, and falls as snow.

5. When the rain-drops freeze as they fall we get hail.

6. Plants rest during winter.

Lesson XX

SPRING (WORK IN THE FIELDS)

The teacher should be provided with Brown's pictures of ploughing, harrowing, and drilling (with details of the plough, etc.). A garden hoe and a rake should also be at hand.

I. A Busy Time

1. *After the break up of the frost and the disappearance of the snow, the teacher would do well to prepare for this lesson by encouraging the children at every opportunity to observe for themselves the changes going on around them, and to make their simple reports to him from time to time about what they see.*

One of the first things to strike them would be that **father is beginning to be busy in the garden** *again. Lead them to talk about this, and to tell of the kind of work they see him doing.*

2. *Then too they see the* **farm hands are equally busy in the fields.** *It is important that they should observe for themselves (under the teacher's guidance as far as possible) the various operations that are taking place in the fields at this time of the year. As these, however, are not all going on at the same time, but follow each other in their natural order, it will be necessary to make more than one visit to the fields for this purpose.*

3. *The lesson itself would be best timed to take place* **early in April,** *when it would be an easy matter, with the help of some good pictures, to deal in class with the various observations made out of doors.*

Commence the lesson by leading the children to tell briefly what they can of the gardens, fields, and trees, as they see them to-day.

What a change from their bare dead winter appearance. First the frost and snow left us. Then everything around us began to **spring up into new life,** and has been growing ever since. That is why we call this season of the year **the Spring.** When Spring comes it is time for man to be busy in the gardens and fields, for **he must do his part.**

Let us think now about some of the work that man does in the Spring.

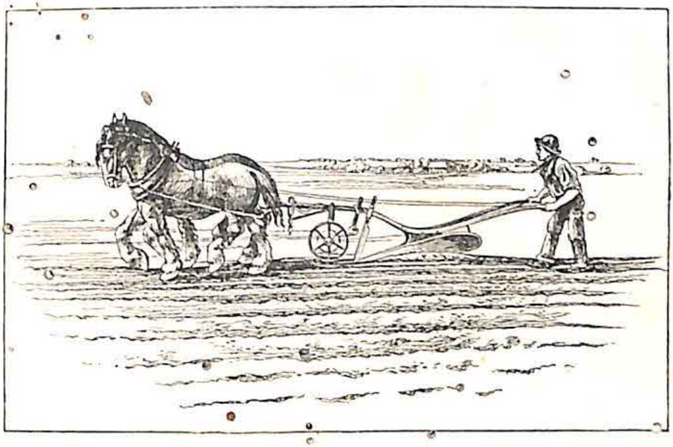
II. PLOUGHING.

1. *Show the picture of the ploughman at work, and proceed to elicit from the children all they can tell about it from their previous observations.*

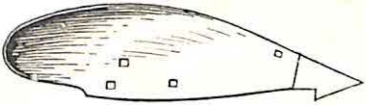
The plough does the same work in the farmer's fields as the spade does in the garden. It **digs or turns up the soil.**

2. *They know from what they have seen that digging with the spade is hard work, and takes a long time. Point out that* it would take **a great number of men several weeks to dig one of the farmer's big fields** all over, *and then*

remind them that he has **many such fields.** Digging with the spade would never do for him.



3. *Call attention to the* **ploughshare.** *The children of course know that it is this part of the plough which does the work of* **cutting through the soil,** *and* **turning it up.**[1] *Notice its sharp cutting-point and edges.*



Tell that it is **made of steel,** *and is always* **kept clean and bright.** Why?

It is hard work for the horses to draw the plough, because they have to **pull the steel share through the soil.**

The ploughman walks behind with the reins in his hands to guide the horses, and keep **the point of the ploughshare well in the soil.**

4. *Explain that some farmers have a very large extent of land to plough, and they find that even powerful horses cannot do the work quickly enough. They use a* **steam-engine** *instead*

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[1] This will be sufficient for the present. The plough will be more fully described in a later stage.

of horses to draw the plough. A steam-engine can do as much work as many horses; it is able to plough **much more land in the same time.** *Some of the children may have seen the steam-plough at work. Assist them to describe it briefly.*

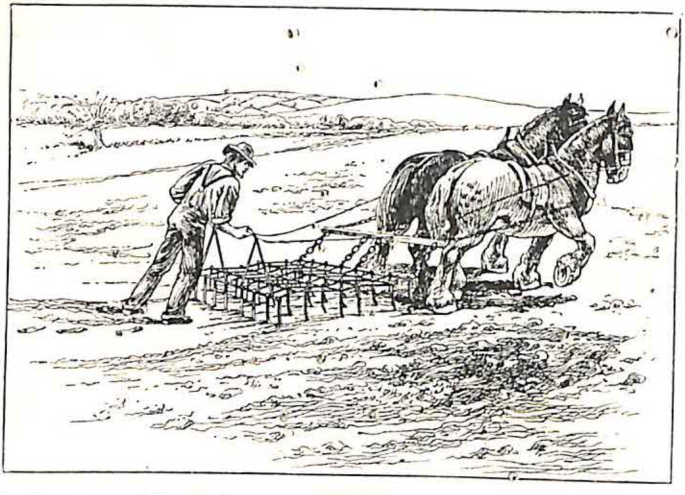
5. Now, last of all, let us see why it is so important to have the soil turned up, if we want anything to grow in it.

You will say at once that the digging or ploughing **breaks up the soil** and makes it soft. So it does, and **the soil must be soft**, or the young roots of the plants cannot make their way down into it.

But besides this it is important **to bring the soil to the surface**, so that the **sun**, and the **air**, and the **rain may act upon it**—otherwise nothing would grow in it. We shall learn more of this by and by.

III. Harrowing

1. *Show the picture, and lead the children to describe the*



implement. **The zigzag seed harrow** *is the one chosen here, as that is the one usually employed on* **arable land,** *the*

chain harrow *being mostly used on* **pasture land.** *It should be remembered, however, that this is sometimes reversed,* i.e. *arable land is sometimes chain-harrowed, and pasture land tooth-harrowed.*

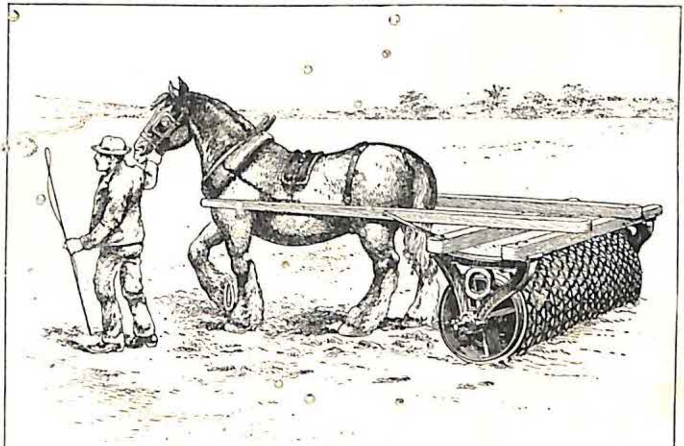
2. *Notice that the implement consists of* **a heavy iron frame,** *to which* **rows of straight, pointed, iron teeth** or **tines** are fixed. The implement has **no wheels.** It **rests upon the points of these tines,** and the weight of the heavy iron frame **presses them into the ground.**

The implement is drawn by horses, and as no two tines follow the same track, the big clods of earth are dragged along by them, and rubbed and knocked about **till they break up and crumble into fine soil.**

The children will readily connect the work of this implement with the work done by the **common garden rake.**

In each case the object is to break up the soil fine, and make it level. We call this a **light seed-harrow.**

3. *Explain that in some heavy lands the harrow is not able*



to break up the clods or lumps of earth. Another implement called a **clod-crusher** *is used for this purpose.*

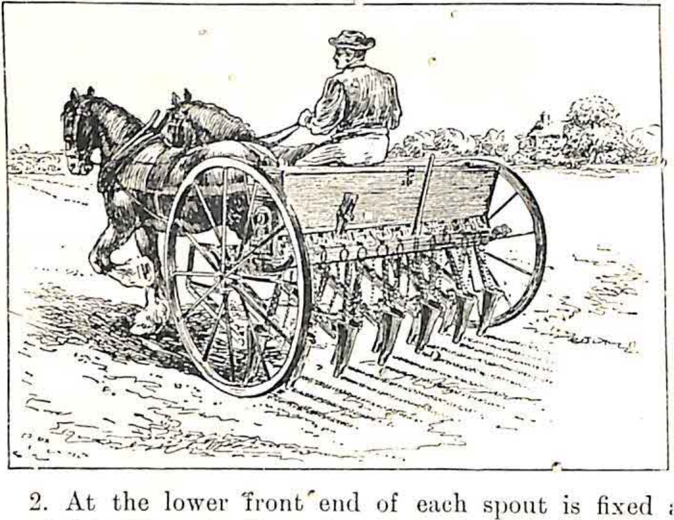
Show a picture of this implement, and tell how it is used. The **great heavy roller** easily breaks up the hardest clods of earth with its **rows of iron teeth.**

IV. Sowing the Seed

1. *Show the picture of the drill, and as before assist the children to describe it.*

It is a large **oblong box on two wheels**, and is drawn by a horse. The box itself is called **the hopper:** it contains the seed which is to be sown.

A number of **tubes** or **spouts, at equal distances apart,** lead from the bottom of the hopper to the ground.



2. At the lower front end of each spout is fixed a **curved knife** or **coulter**, the point of which dips below the end of the spout.

After pointing all this out on the picture, tell that as the drill, filled with seed, moves across the harrowed field, **the coulter cuts a little groove** in the soil, and the seeds fall into this groove from the spout, one or two at a time.

3. *Elicit that with this implement* the seed is **sown in long straight rows.** The farmer's crops always grow in long straight rows, because he sows the seed with a drill.

Compare this with the old-fashioned way in which seeds are often sown broad-cast in the garden. Perhaps some of the children have seen father sow an onion bed in this way.

4. *Lead them to tell of the work of* **thinning out** *such a bed.*

Why is it necessary to thin out the bed? Some of the young plants must be pulled up **to make room for the others to grow.** Plants must have room to grow, or they choke one another.

Show the advantage of drilling the seed. Drilled seeds do not require to be thinned out when they spring up, because the seeds fall from the spout one or two at a time. **The young plants are never too thick on the ground.**

5. *Elicit, or tell if necessary that, after the seed is drilled in, the ground is again harrowed, and then rolled.*

What does father do after he has sown the seeds in the garden? He rakes the beds over with the rake.

Why does he do this? To **cover the seeds** with the soil.

In this way lead the children to discover for themselves the reason for this second harrowing. The seed must be covered lightly with the soil.

Tell that on heavy lands a light roller is used instead of the harrow to press the seeds into the soil.

V. HOEING

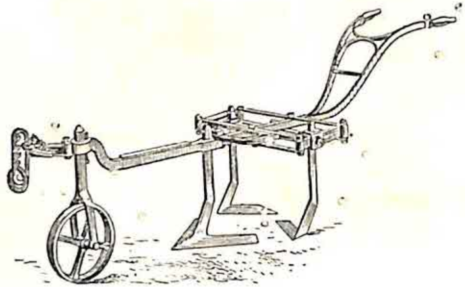
1. *Pass on next to think of the weeds that spring up and grow with the young plants.*

Weeds must not be allowed to grow, or they will **rob the young plants of food, light, and air,** and soon choke and kill them.

How does father get rid of weeds in the garden? He **cuts them up** with a hoe.

Show the common garden hoe, and tell that it is sometimes used in the fields. Most of the work, however, is done with the **horse-hoe**. *Describe it and show a picture of one.*

2. **The horse-hoe** consists of an **iron frame** with **three or more long curved tines** fixed to it. Each tine has a **pointed shoe-like knife** at the end of it.



The implement has one small wheel in front (a very large one has two wheels), and it is drawn by a horse.

The shoe-like knives cut through the weeds and root them up.

Show that such an implement could not be used on land sown broad-cast.

SUMMARY OF THE LESSON

1. Spring is the growing season of the year. It makes people busy in the fields and gardens.

2. The soil must be ploughed so that the sun, the air, and the rain may act upon it.

3. The harrow breaks up the big clods of earth into fine soil.

4. The drill sows the seed in long straight rows. The young plants are never too thick on the ground.

5. Plants are hoed to get rid of weeds, which would kill them.

Lesson XXI

SPRING (A RAMBLE)

It would be well to follow up the teaching of the last lesson, if possible, by taking the children for a ramble a few days later—that is, **about the middle of April.**

I. TREES BEGIN TO BUD

Call attention on the way to the **hedgerows** *and* **trees.**

When we saw them in the winter-time they were quite bare—all their leaves were gone. They are now green once more. **The new leaves have come.**

Cut off a twig from one of the later trees, which has not yet broken out in full leaf, and let the children examine it for themselves.

Call attention to the **little pale-green knobs** *on it.*

Notice that each of these little green knobs is covered up with a **sort of shell or case**; *that the knob swells up bigger and bigger, till at last* **the outer case splits and falls off.**

Notice too that there is a sticky substance all over the little knob and its case.

Take another twig now in which the growth is more advanced. The little green knobs on this one have opened, and **spread out to form leaves.** We call these little green knobs the **leaf-buds.** It is the warm sun that makes them grow, and open out to form leaves.

II. THE FIELDS ARE GREEN

Notice the farmer's fields next.

The meadow-lands, where we saw the men carting and laying down manure in the winter-time, are now green with the new young grass. This will give **a fine hay-crop** by and by.

The other field farther on looks green too, but it is **not green all over** like the meadow. As we get nearer we see that the little green plants in it **stretch in long lines or rows,** a few inches apart, from one end of the field to the other.

Examine these little plants more closely. **They look just like grass.**

Elicit that they are not common grass like the grass in the meadows; **they are little wheat plants.**

The grains of wheat, which the farmer drilled in the soil, have **sprung up into these little green plants,** that look like blades of common grass.

Explain that **this field was ploughed and sown before the winter frost came.** The farmer sows most of his corn then.

III. Wild Flowers of Spring

The children will not be long before they are attracted by the wild flowers which they meet with on the way. Let them disperse themselves in various directions, and gather whatever flowers they can find—**in the meadows,** *by the* **hedgerows,** *and* **round the margin of the wood** *or* **coppice.**

The flowers available will to some extent depend upon the locality, but in most woods the **violet, primrose, wood-anemone** *or* **wind-flower, periwinkle, yellow dead-nettle, blue-bell,** and **daffodil** *are plentiful enough about this time; as are also* the **cowslip, daisy, coltsfoot,** and **lesser celandine,** or **pile-wort,** *in the meadows and on the banks.*

On their return take a few of the characteristic flowers, and compare them one with another in a simple way, as to **form, colour, size,** *and* **perfume.** *This, of course, must be done without any attempt at naming the various parts, for they know very little of the nature of the flower yet. The one object should be to awaken in the children* **a spirit of inquiry,** *and* **a love for all the common things** *they see around them.*

It will be sufficient for the present to deal with such well-known flowers as the primrose, violet, daisy, daffodil, and wild hyacinth (blue-bell).

1. THE PRIMROSE.—*Commence with this, and let the children tell exactly where they found it*—**usually on a bank or round the margin of the wood.**

Dissect the flower carefully and point out :—

(*a*) The **little cup of green leaves** (or rather leaf, for it is all in one piece) which holds it to the stalk.

(*b*) The **five delicate pale-yellow flower-leaves**, all joined together in the middle, to form a sort of **long tube**, which rests in the bottom of the green cup.

(*c*) The **five little stalks**, with a **larger one in the middle**, which stand up in the centre of the cup.

This is the primrose—**the flower of spring.**

2. THE VIOLET.—This was found **on a shady bank** or **in the woods.** *Notice its rich colour*—**violet,**—*and its* **sweet perfume.**

Proceed to dissect it as before, and show that it has **the same cup of green leaves, the same five richly-coloured flower-leaves,** *and* **the same little stalks** *standing up in the middle.*

Notice, however, that the five green leaves of the cup, and the five flower-leaves **are all separate.** *There is* **no tube.** *The lower flower-leaf of this flower forms* **a little spur** *near the stalk.*

3. THE WILD HYACINTH, OR BLUE-BELL.—*Notice how these little delicate blue flowers hang one above the other on their stalk. Call attention to their delicious perfume. Compare the flower-leaves with those of the other flowers.* They are **all joined together to form a pretty bell**; hence their name.

Elicit that these flowers were gathered **in the woods,** *or* **on some shady bank or hedgerow.**

4. THE DAFFODIL.—*A flower of the woods. The children's* **Daffy-down-dilly.** *Compare this with the others. Notice the* **six long pointed flower-leaves,** with the **large deep cup** in the centre, like a bell. It is a **bright yellow flower,** but the bell is of a brighter, deeper yellow than the other parts.

5. THE DAISY.—*This flower should be specially noticed and dissected, because it is so very unlike any of those which have been examined.*

Point out that the **yellow disc** *in the centre really consists of* **an immense number of tiny little flowers** *packed close together, on the top of the flower-stalk.*

These little flowers are called the **florets.** There is a **ray** of long **white florets all round the centre disc.**

The daisy is a meadow flower. *Speak of its name* the **"day's eye."** *Ask the children to observe for themselves that, as evening comes on, the long white florets close up round the centre disc*—**the flower shuts its eye at night, but opens it next morning.**

6. *Do not omit to encourage them to be on the constant look-out for more of these spring flowers from day to day, and instruct them where to search for what they want to find.*

In a few weeks the meadows everywhere will be gay with **buttercups, daisies,** *and* **cowslips.** The **pink ragged robin** or **cuckoo-flower,**[1] the **yellow and purple comfrey,** and the **bright golden marsh-marigold,** *will all be in full bloom according to the locality; while on almost every shady bank will be seen* the **forget-me-not, woodruff,** *and* **wild strawberry.** *These are a few of the wild flowers of spring, with which the children might easily make themselves familiar, with a little help from teacher.*

[1] N.B.—The name "Cuckoo-flower" seems to have been given, in different parts of the country, almost indiscriminately to a number of flowers, because they come with the cuckoo. Thus in one district the cuckoo-flower is the marsh-marigold, in another it is the stitchwort, in another the lady's smock, and in another the ragged robin.

IV. THE CUCKOO AND THE SWALLOW

1. *Of course it would be almost impossible, at this time of the year, to avoid hearing the cry of the cuckoo, in any part of the country.*

Listen to the well-known notes, and proceed to elicit all the children can tell.

Cuckoo is **the call or cry** of a bird, about twice as large as a thrush. We name the bird itself **the cuckoo** from its cry. We often hear the cry, but we seldom see the bird.

2. Why are we always pleased to hear the cuckoo? Because it tells us that **winter is over,** and **spring is here.** We call this bird **the bird of spring**; and sometimes the **harbinger of spring.**

Why don't we hear the cuckoo in the winter?

Tell that this bird is not in our country in the cold winter time. It does not like cold weather. **It comes to visit us every spring**—*about the middle of April, but it does not stay long, for* **it always leaves us in August.** *It flies away then to the warm sunny lands of the south, and stays there till our winter is all over.*

3. *Call attention to the* **swifts** *and* **swallows** *on the wing. Notice their peculiar flight. Tell that* **these birds are also visitors** *like the cuckoo. They come to us every spring—usually arriving* **about the second week in April,** *and they stay with us till* **the middle of September,** *when they too leave us for warmer lands in the south. But they always come back when our winter is over.*

N.B.—*This part of the subject will be dealt with more fully in the next stage.*

SUMMARY OF THE LESSON

1. The buds on the trees open into new leaves in the spring.

2. The farmer's crops begin to grow, and make the fields green.
3. Wild flowers spring up everywhere.
4. The primrose, violet, blue-bell, and daisy are the first of the wild flowers.
5. The cuckoo and the swallow come back in spring.

Recapitulate in class with the help of Brown's pictures of (1) "The Wild Flowers of Spring"; (2) "The Cuckoo and Swallows."

ANIMALS KEPT ON THE FARM

Lesson XXII

SHEEP AND COWS

Provide for illustration Brown's pictures of the "Animals on the Farm," a ram's head and horns, and details of the feet, teeth, and stomachs of the animals.

A specimen cow's horn and an actual sheep's skull would be found most useful. The latter may be easily prepared by boiling the flesh away from a sheep's head, after which the bones may be cleaned and polished. Of course some care is necessary in choosing a perfect specimen.

In preparation for the lesson it would be well to direct the children to take careful notice of the sheep and cows in the fields, in order that they may be able to follow the teaching intelligently from their own observation.

I. GENERAL APPEARANCE

1. *Show a picture of the two animals side by side. Lead the children, with the help of the picture, and by means of their own observation from day to day, to point out the most obvious features of both as follows:—*

The cow is a **big, heavy, thick-set animal,** almost as large as a horse. The **head** is **small** compared with the great bulky body, and it has **a short, thick neck.** The **legs** are **short, thick, and strong-looking, just fit to support the heavy body.** The cow has a great bag or **udder** to hold her milk.

2. *After eliciting these points one by one, proceed to compare the animal with the sheep, telling nothing, of course, but what the children fail to observe for themselves.*

The sheep is a much smaller animal; it is **about the size of a large dog.** Its **legs** are **long** and **slender,** not thick and strong like those of the cow, because **they have less weight to hold up.**

II. The Head

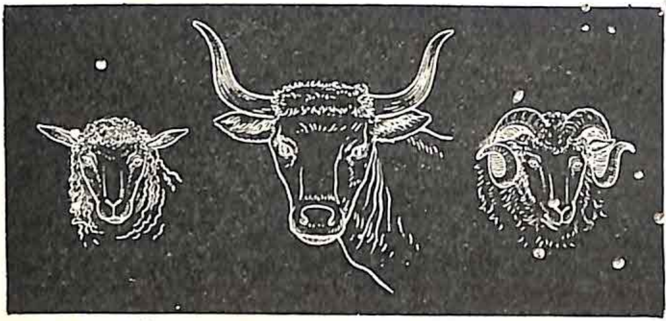
1. *Call attention to the* **broad, flat forehead,** *and the* **square muzzle** *of the cow, and compare it with the head of the sheep, which is* **rather pointed.**

Notice that both animals have **large eyes,** *which are* **placed at the sides of the head** *and not in front;* **ears that can be raised erect** *in an instant; and* **large nostrils.** The nostrils of the cow are **very large and wide open.** *Elicit that they are both* **timid, gentle** *creatures—a sheep will begin to bleat and run away if only a little child goes near it.*

2. *Tell that, as these animals cannot fight, they have only their legs to depend upon for safety, if any enemy comes near.*

Those large eyes **at the sides of the head** enable them to **see well in every direction**; the **large, erect ears** can **catch the faintest sound**; and the **wide-open nostrils** help them still further by **scenting an intruder** even at a great distance. They thus get timely warning if any danger approaches, and are able to make off at the top of their speed.

Lead the children to tell that the animals in running must get out of breath, and that they require to breathe hard to take *in plenty of air. This will readily suggest another purpose of those wide-open nostrils.*



3. Now look at the picture again, and you will notice something on the cow's head, which you do not see on the sheep's head.

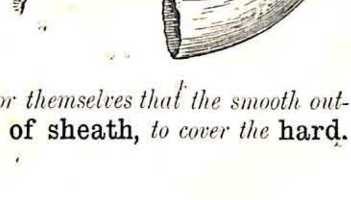
What do I mean? The cow has **horns**; the sheep has not.

This will no doubt lead some of the children to tell that they have seen sheep with horns.

Show the picture of the **ram.** *Elicit that this is the* **male sheep.** *Call attention to the* **large twisted horns.** *Explain that in some countries* **the ewes have horns as well as the rams,** *but their horns are never so large and strong as those of the male sheep.*

Notice that the **cow's horns** are **smooth on the outside**; but the **horns of the sheep** are **crossed with ridges,** which give them a rough, wrinkled appearance.

If a specimen cow's horn can be obtained, let the children examine it, and discover for themselves that the smooth outside part is nothing but a **sort of sheath,** *to cover the* **hard, bony core inside.**



III. The Covering of the Body

1. *Notice next the coverings of the two animals.*

The **cow** has a **thick skin** or **hide** covered with **short, coarse hair**; the **sheep** has a **thick coat of wool.**

Point out the fitness of each covering for the needs of the animal. Sheep require a warm coat, for **they are exposed,** *night and day,* **to all weathers,** *but the cow is well housed all through the winter.*

Tell that in some cold northern lands the hair of the cow **becomes thick and shaggy,** almost like coarse wool.

2. *Notice next the* **cow's long tail,** *with its* **thick tuft of hair at the end.**

Who has seen the cow on a hot summer day whisking her tail in all directions? Why does she do this?

Explain that flies and other insects are very troublesome to her in hot weather. They settle on her head and neck and body, and worry her.

She uses her long tail with its tuft of hair to drive them off.

Point to the short tail of the sheep. Explain that the **flies cannot get to the skin** *through that thick coat of wool.*

These animals **do not want a long tail** to whisk the flies off.

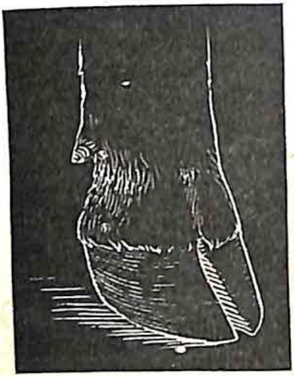
IV. The Feet

1. *Ask the children to describe, from their own observation, the feet of the cow and the sheep. Lead them to tell that in both animals the foot is divided by a deep cleft down the middle. Then call attention to the picture, and show that the foot seems to be made up of two toes.*

The inner surfaces of the two toes fit closely together, as though the foot had been split down the middle.

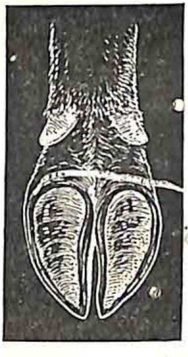
Notice next that each toe is encased in **a hard, horny covering,** *which we call* **a hoof.**

We call the foot of the cow and the sheep **a cloven hoof,** because it is split in two. The word **cloven** means **split in two.**



2. Look now at the feet once more. How many toes do you find in the cow's foot? Four; two large ones in front and two short ones behind.

Explain that in walking, the cow **never touches the ground with these two hinder toes;** *and then point out that the foot of the sheep has also four toes. It is in every respect like that of the cow; the sheep, too,* **walks on its two front toes.**



3. *Examine the under part of the cow's foot. Notice the* **broad tread,** *and explain that* **the two toes spread out** *with the weight of the animal in walking.*

Contrast this with the **small foot** *and* **close-fitting toes** *of the sheep. Point out that the cow's natural home is on the low grassy plains and meadows. Its broad spreading foot is well fitted for the damp, soft soil of the meadows, but it would slip about on the smooth surface of the hill. Sheep on the contrary can climb the hills well; but their small feet would sink into the soft soil of low-lying meadows.*

V. HABIT OF FEEDING

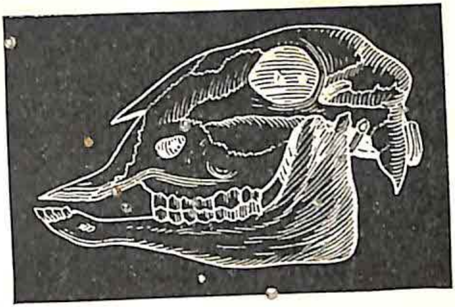
1. *Lead the children in the next place to give their simple observations on the way sheep and cows feed.*

They have watched the animals in the fields tear off the grass mouthful by mouthful, and swallow it at once. They have seen *that after walking about and feeding in this way for some time, the animals either lie down or stand quite still, moving their mouths all the while, as if they were chewing.*

Explain that **they are really chewing**—*that cows and sheep feed in the same way.*

2. *Produce the sheep's skull, or show a picture where the real thing cannot be obtained.*

Call attention to the **broad flat-crowned teeth** *in the back of each jaw. These are* **the grinders.**



Lead the children themselves to discover that there are **no teeth whatever in the front of the upper jaw**; *and explain that the cow's jaw is exactly the same. Tell that, in the place where the teeth would be in the upper jaw, there is* **a hard thick pad of gristle.**

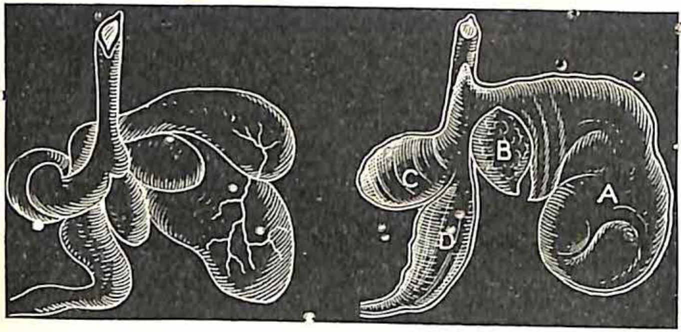
3. While they are feeding, these animals collect up tuft after tuft of grass with their **long flexible tongue** and **lips.** The sharp, cutting teeth in the lower jaw then hold the grass firmly against the hard pad in the upper jaw, and with a smart jerk of the head the little tuft is either **torn** or **cut off** and swallowed.

This is the way in which cows and sheep feed. They swallow their food without waiting to chew it first.

4. *Explain that the great difference between these animals and others is, that cows and sheep have* **four stomachs** *instead of one.*

Show a good diagram of this, or sketch the arrangement on the blackboard.

The grass is swallowed **without chewing** into a large bag, which we call **the paunch,** or **first stomach,** and the animal goes on collecting it up and swallowing it until the paunch is full. While it lies at rest, the grass is passed from the paunch into another and smaller bag, **the second stomach,** which has little hollow cells all round its sides, something like a honeycomb.



The grass collects in little **cuds** or **pellets** in these hollows, and the cuds **are then passed up into the mouth again,** one by one, to be chewed.

5. This is really what the sheep and cows are doing as they lie so quietly on the ground. Those broad, flat, grinding teeth **act like the mill-stones of a mill,** and crush up the grass.

Ask the children to watch the cows and sheep chewing. They will notice that **their jaw moves from side to side, as well as up and down. All chewing animals eat in this way.**

After being well chewed the grass is again swallowed, but it goes into another bag now—**the third stomach;** and from this it passes into another—the fourth, or **true stomach,** to be digested. This way of eating is called **chewing the cud.**

SUMMARY OF THE LESSON

1. Sheep and cows are timid animals. They have large ears, and their eyes are placed at the sides of the head—not in front.

2. The sheep has a thick fleece of wool, to fit it to live in the open air all the year round.

3. The cow has a long tail to drive off the flies. Sheep do not want a long tail.

4. Sheep and cows have cloven hoofs. They walk on the two front toes.

5. Sheep and cows have no teeth in front of the upper jaw; they have strong grinding teeth behind.

6. Sheep and cows have four stomachs. They chew the cud.

Lesson XXIII

THE HORSE (COMPARED WITH THE DONKEY) (1)

The teacher should be provided with Brown's pictures of (1) the "Animals on the Farm," and (2) details of the teeth, mouth, and hoofs of the animals. Specimens of horse-leather and parchment should be shown, and a horse's bit should be borrowed if possible for the lesson.

The children, as usual, should be directed to make their own observations from time to time in preparation for the lesson.

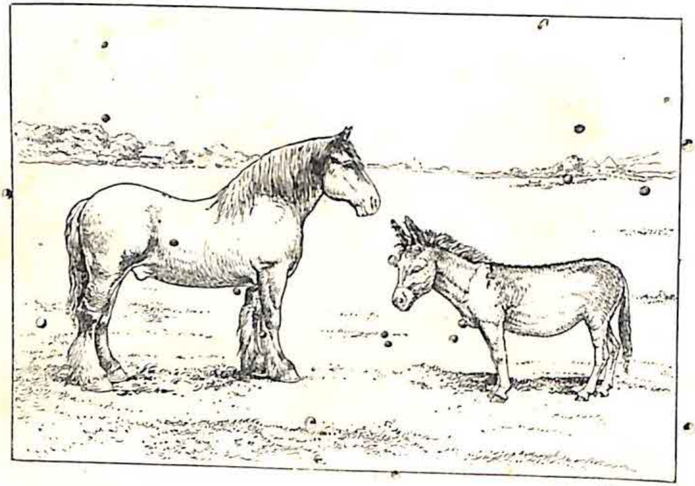
I. INTRODUCTION

1. *Introduce the picture, calling attention to the horse and donkey side by side, and commence the lesson by leading the children to tell, with the help of these, and from their own observation, such points as the following:—*

The **horse** is a big, strong animal, **larger than the cow.** He is **quiet, gentle, obedient,** and **very sensible;** he is one of the most useful of all our domestic animals.

2. *Compare the* **donkey** *with the* **horse** *in these respects. Notice that both have* **the same general appearance,**

except that the **donkey is smaller** *than the horse. Tell that the donkey is quiet, gentle, obedient, and sensible too* **if he is well treated**; *but some people are very cruel to him*, and then he often becomes **stupid** and **obstinate.** But that is not his fault.



3. *Remind the children that we do not eat the flesh of these animals, nor do they supply us with milk as the cow does.*

The horse and the donkey are useful as **beasts of draught and burden.**

Elicit that there are several different kinds of horses—**cart-horses, carriage-horses, hunters,** *and* **race-horses**—*and each is useful in its own way. Explain* **mare, colt, foal, filly.**

II. Body, Head, and Neck

1. Build of Body.—*Turn now to the picture of the horse, and notice the following points, leading the children to discover as much as possible for themselves, and telling only where they fail:—*

The body is **long** and **rounded,** with a **deep, broad**

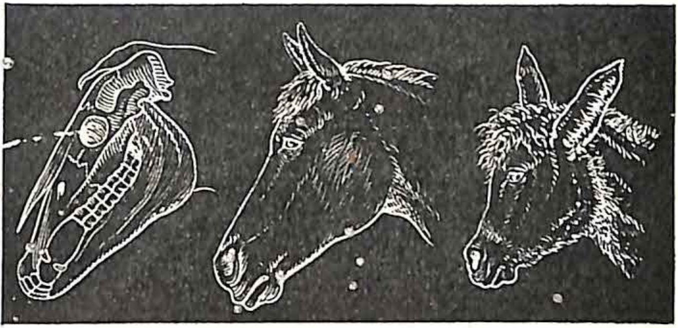
chest, a **curved back,** and **powerful haunches.** It is built for strength and endurance.

Picture a horse tugging a heavy load along. It is those **powerful haunches** *that do the work. Notice* **the hollow** *in the middle of the back; it makes an* **easy and secure seat** *for his rider.*

The **horse** is **a running animal.** He would not be able to run, and draw heavy loads, if he had a narrow chest and small lungs. How hard he breathes while running. That is to keep his big lungs **filled with plenty of air.**

Elicit and show that **the donkey's body,** *although smaller, is in all these respects* **like that of the horse.**

2. THE HEAD AND NECK.—*Lead the children to continue their observations:—*



The **head** is **long** and **somewhat pointed** towards the muzzle; the **jaws** are especially **long.** The **neck** is **long** and **arched,** and its upper edge is covered with hair which we call a **mane.**

Picture the horse and donkey in the field, and lead the children to explain the **advantage of a long head and neck** *to these grazing animals. Compare them with the cow in this respect.*

Note next the difference between the manes of the two animals.

The hair of the horse's mane is **long and fine,** and **flows over the neck**; that of the donkey is **short and coarse,** and **stands up** almost like **bristles.**

3. THE EYES.—In both animals the **eyes** are **large** and are **placed at the sides of the head,** and not in front. What do we learn from this about the nature of the animals?

Lead the children to prove from their own observation that both the horse and the donkey are **timid animals** *even in their domestic state. They will quickly* **take fright** *and* **shy,** *if they see anything strange. Show from this the* **purpose of the blinkers,** *which they are made to wear over their eyes.*

4. THE EARS.—The **ears of the horse** are **short, erect,** and **pointed**; those of the **donkey** are **much larger.** Both animals are very sharp of hearing; they "prick up their ears" at the least sound. **All timid animals do so.**

A bad-tempered horse **throws his ears back.**

5. THE NOSTRILS, like those of **all timid animals,** are large, fleshy, and open. They have a **keen sense of smell,** and they are also **of great service in running.** Why?

Compare with the cow and sheep.

III. COVERING AND TAIL

1. THE COVERING.—*Compare the covering of the two animals next, leading the children to point out that* **the horse** *has* **a smooth, glossy coat of fine, short hair,** *while the* **donkey's covering** *is a* **rough, shaggy coat of coarse, thick hair.**

Elicit, or tell if necessary, that the horse's coat grows thicker and longer in the winter, but on the return of spring his master *has it clipped close again, and frequently washes and scrubs him down* **with a curry-comb.**

The donkey's coat grows too, but nobody thinks of clipping it or taking care of it. The poor donkey's life **is a rough, hard one** compared with the life of the horse.

Notice next the colour of the coat, and lead the children to tell that there are **white, black, bay, dun, grey,** *and* **dappled horses.**

The **donkey's coat** is always **grey,** with **one dark stripe across the shoulders,** and another **along the middle of the back.**

2. The Skin.—*Tell that the skin or hide of the two animals is as different as their covering.*

The **horse's skin** is **thick,** but **not so thick and hard** as the cow's hide. It is **sleek** and **soft to the touch.** When the animal is dead its skin is made into **useful kinds of leather** for covering chairs and sofas, for making harness, and for stout, strong driving-gloves.

The **donkey,** to make up for its thick, rough coat, **has a thinner skin** than the horse. It is made into a **thin kind of leather called parchment.**

Show specimens of these leathers.

3. The Tail.—The actual tail of the horse and the donkey is **short, thick, fleshy,** and **pointed.** The horse's tail is **entirely covered with long, stiff hairs,** which hang down to the ground. The donkey's tail **is covered with short, coarse hair** like that on the body, and **it has a tuft** of long hair at the end.

Summary of the Lesson

1. The donkey, although smaller than the horse, is like it in build.

2. The horse has a smooth, glossy coat and a long mane; the donkey's coat is rough and shaggy, and the mane stands up like stiff bristles.

3. The horse has a tail of long stiff hairs which hang down to the ground; the donkey has a tuft of hair at the end of its short fleshy tail.

4. Both are running animals.

5. Both have erect pointed ears, but the donkey's ears are larger than those of the horse.

6. In both the nostrils are wide and open, and the eyes are placed at the sides of the head. They are timid animals.

Lesson XXIV

THE HORSE (COMPARED WITH THE DONKEY) (2)

Provide for illustration the pictures used in Lesson XXIII.; a horse-shoe and nails; a horse's bit; a sketch of the skull.

I. Introduction

1. *Show the picture of the two animals once again, and commence with a few minutes' rapid questioning on the last lesson.*

Let the few questions asked be framed in such a way as to bring out the comparison, point by point, between the two animals, so far as it has been dealt with already.

The tail of the rough, shaggy-coated donkey is altogether different from that of the sleek-skinned horse. Why?

Lead the children to think of the tormenting flies and other insects in the hot summer weather, and they will readily answer this question.

2. *Lead them next:—*

(*a*) *To describe the structure of eyes, ears, and nostrils.*

(*b*) *To explain the connection between this structure and the nature of the animals.*

Why are the donkey's ears so much larger than those of the horse?

Why are blinkers placed over the eyes of horses and donkeys? To prevent these timid animals from seeing anything that might frighten them, and cause them to shy.

Elicit, step by step, that these side shutters shut off the view of everything on both sides of the animal, so that **it can only see straight ahead**; *that the driver in the cart or waggon behind guides and directs it by means of the reins; and that as he is sure to choose the best and clearest part of the road,* **there is nothing to frighten the animal and make it start.**

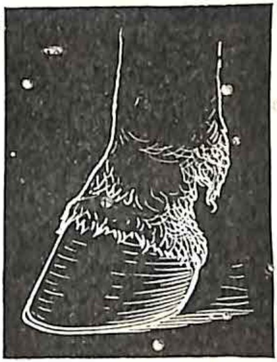
Show how necessary this is by picturing what damage a runaway horse would do.

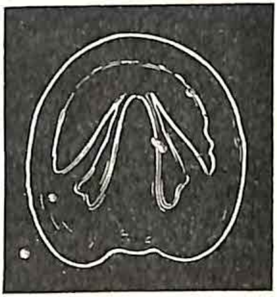
II. Legs and Feet

Let us now see what else there is to learn about these two animals.

1. *Note that in both animals* **the upper part** *of all four legs is* **short, thick,** *and* **strong-looking,** *the* **lower part long** *and* **slender**—*the very best form of legs for* **running animals.**

The **foot** is all in **one solid piece**; it is really **a single toe.**





This toe is enclosed in **a horny case** or **hoof,** like the hoof of the cow; except that **it is not cloven.**

2. *Show a picture of the under part of the hoof, or make a sketch of it on the blackboard.*

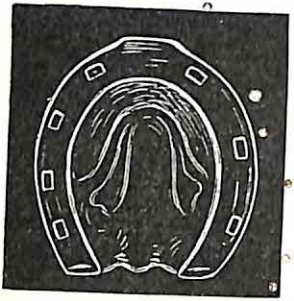
Notice that it is **hollowed out** *from below; that there is* **a thick, fleshy lump,** *called the* **frog,** *in the middle of the hollow, and* **a broad rim round the edge.**

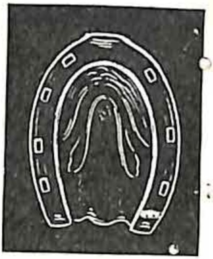
Point out the difference in the shape of the two hoofs.

The **horse's hoof** is **almost round**; **that of the donkey** is more **oval** than round.

3. *Show a horse's shoe, and explain that this is made to fit the rim of the hoof.*

It is nailed to the hoof without causing any pain, **because there is no feeling in that hard, horny case.** The farrier can cut and trim the hoofs, just as we cut and trim our nails; for both are made of the same kind of horny substance.





Remind the children that these animals in their wild state **live on the smooth, grassy plains,** *and their hoofs (like our nails) grow as quickly as they wear out.* **They do not require shoes.**

Our domestic horses and donkeys have to travel and draw heavy loads **over rough, stony roadways,** and their hoofs would wear away more quickly than they can grow. This is why **we nail iron shoes to them.** It is to preserve them—to prevent them from wearing away too fast.

4. *Tell that wild horses and asses, when they cannot escape from their enemies by running away, fight them by kicking with their hind-legs. This is their only means of defence.*

It will interest the children to learn that in some lands oxen are used, as we use horses and donkeys, to draw the plough and pull carts and waggons, and that iron shoes, like those which we see on horses' feet, are nailed to their hoofs, to keep them from wearing out on the rough, stony roads.

5. *There is one other point worth notice in connection with the legs.*

Ask the children whether they have ever watched a cow and a horse get up on their feet after they have been lying or resting on the grass. If they have not, tell them to keep their eyes open next time, and they will see that **the cow kneels on her fore-legs,** *and* **gets up on her hind-legs first,** *while* **the horse throws out the fore-legs first,** *and raises himself on his hind ones afterwards.* **The donkey rises in the same way as the horse.**

III. TEETH AND HABIT OF FEEDING

Lead the children to describe briefly and rapidly the nature of the cow's teeth, and then proceed by means of the picture to compare them with the teeth of the horse and the donkey.

1. GRINDERS.—*Notice first the rows of* **great square teeth** *in the hinder part of each jaw, and let the children tell the purpose of such teeth.*

These teeth are like those of the cow, and are **meant for chewing.** The food of the horse and donkey (like that of the cow) is **entirely vegetable,** consisting of grass, hay, corn, thistles, etc.

With great grinding teeth like these what would you expect to find, as regards the movement of the jaw itself? **The jaw should move sideways** as well as up and down.

Why? Because the sideway movement causes the rough edges of the teeth to rub against each other, and so **grind the food,** as corn is ground between the rough edges of the mill-stones of a mill.

Tell that the **jaws of the horse and the donkey** *actually* **have the same double movement** *as we noticed in the other chewing animals.*

2. CUTTING-TEETH.—*Now notice the front of the mouth.* The horse has **no pad in front** of the upper jaw as the cow has. There are **six sharp cutting-teeth in front of each jaw.**

Tell that the horse and the donkey **do not chew the cud.** *They nibble off the grass with their sharp front teeth, and* **chew it at once** *before swallowing it.*

They have **one stomach,** *not four as the cow has.*

Their **thin, delicate lips** have a fine sense of touch, and **help the animals to choose their food.** The **horse** is **very particular** over his food, but **the donkey** will leave everything else **for a few thistles.** Both animals are very dainty over the water they drink. **They will only drink clean water.**

3. THE BAR.—*Notice next the pointed tusks on either side of these cutting-teeth, and then call attention to the* **wide gap** *or* **space** *between them and the grinders.* **This space is known as the bar.**

Show a **horse's bit,** *and tell its use. Explain that when the bit is put into the horse's mouth,* **it fits into this space** *without causing any inconvenience.*

Point out that if the teeth were placed all round the jaws as ours are, it would be impossible to put the bit into the horse's mouth—at least he would not be able to close his mouth with the bit in it.

SUMMARY OF THE LESSON

1. The horse and the donkey have solid hoofs.
2. The horse's hoof is round; that of the donkey is oval.

3. The thick, fleshy lump in the middle of the hoof is called the frog.

4. The horse and the donkey have cutting-teeth in front of both jaws, not a pad like that of the cow and the sheep.

5. The space between the tusks and the grinders is called the bar. The bit fits into the bar.

6. Both animals have large, strong grinding teeth for chewing their food.

7. They have one stomach, not four. They do not chew the cud.

Lesson XXV

THE PIG

The teacher will require Brown's picture of the animal, with details of skull, teeth, and feet. Specimens of pig-skin leather and bristles should be shown if possible.

I. INTRODUCTION

1. *REMIND the children of their visit to the piggery at the farm. Point out that when we were there we talked about the houses, but had very little to say about the animals that live in them. To-day we are going to see what we can learn about the pig itself.*

The children will of course be on very familiar ground now, for most of them have their pig at home. Show the picture and proceed in some such way as this :—

Here he is. What other name do we give him besides pig? His other name is **hog.**

What is the mother pig called? She is called a **sow.**

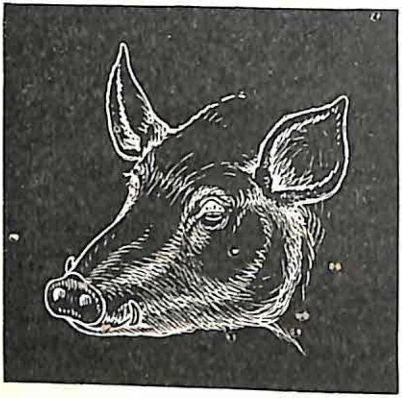
What is the name of the male pig? A **boar.**

What do we say about these and all other animals that we rear and keep about our homes? We say they are **tame** or **domestic animals.**

2. The pig, then, is another of our domestic animals, and a very useful animal it is.

the cow or the sheep, and show that in either case it must starve, or learn to eat different food.

The soft movable lips of the sheep and the cow are fitted for the work they have to do, but **that work is not rooting and grubbing in the ground.**



2. THE MOUTH.—*Notice the great mouth with its large, powerful teeth in both jaws. Besides great* **grinding teeth** *at the back, like those of the sheep, it has a row of front teeth* **in both jaws,** *and* **four large, sharp-pointed teeth,** *one on each side of the head, and in the upper and lower jaws. Sheep and cows have no teeth like these.*

In the boar, that is the male animal, these four pointed teeth grow into **great curved tusks,** which stand out from the sides of his mouth.

Tell that the wild boar is one of the most terrible animals of the forest, because of his great, sharp tusks, which he can use with dreadful effect against his enemies, ripping their bodies open and tearing them to pieces with them.

3. SIGHT AND HEARING.—The eyes are **small** and **deeply set,** and the **ears** rather **large** and **upright.** The eyes of the common pig seem dull and sleepy, but in the wild state, where the animals have to be on the watch

for their enemies, both **sight and hearing are very sharp.**

Compare the pig with the sheep in this respect. The eyes of the sheep are large, timid, and watchful—**ready to take alarm at the least sign of danger.**

4. THE BODY.—The body is **round like a barrel**, the **neck** very **short**, and the head in a line with the back. It has a **short, thin tail**, which is usually **twisted into a curl.** The skin is hard and thick, and covered with stiff hairs which we call **bristles.**

5. THE LEGS AND FEET.—The legs are short, and the feet are **cloven** like those of the sheep. The foot has **four toes**: the two front ones are covered with a **horny, cloven hoof**; the hinder pair are smaller, and **do not touch the ground** in walking.

Now what did we learn about animals with cloven hoofs? They chew the cud.

Yes, most of them do, but the pig, although it has a cloven hoof like those of the sheep and the cow, **does not chew the cud.**

It has only **one stomach**—not four as they have—and it chews its food before swallowing it.

Picture the animal feeding. It eats and eats as long as there is anything before it, and then most likely rolls over and dozes with its little eyes almost shut. But **we never see its jaws moving in the act of chewing at such times.**

IV. OTHER USES OF THE PIG

You told me how useful the pig's flesh is for food. Let me now tell you the uses we make of some other parts of the animal.

1. THE SKIN.—The skin is sometimes taken off, and can be tanned into a very useful kind of leather for covering saddles for horses. We call it pig-skin leather.

2. THE BRISTLES. — The stiff hairs which cover the body are very useful in many ways. We use only those which grow on the back, as they are thick and strong.

Lead the children to think of brushes and brooms of various kinds. The long bristles are used for making sweeping-brooms; the short stiff ones (sometimes black, sometimes white) are made into **hair-brushes, clothes-brushes, tooth-brushes.**

Who has seen a shoemaker sewing a shoe? What does he use instead of a needle? A **bristle.**

Explain why he uses a bristle, how he fastens it to his waxed thread, and how he works with it.

SUMMARY OF THE LESSON

1. The pig does not chew the cud. It has only one stomach.
2. It has teeth in front of both jaws.
3. It has a strong snout for grubbing in the ground.
4. The pig, like the sheep, has a cloven hoof.
5. We eat its flesh; its skin is made into leather, and we use its bristles for making brushes.

Lesson XXVI

MILK

Have ready on the table a glass of new milk, another which has been standing some time, a jug of water, three or four tumblers, a glass marble, and a piece of cork.

Brown's picture of "Milking-Time."

I. PROPERTIES

1. *HOLD up a glass of milk before the class.*

You all know what this is. You see milk on the table at meal-times every day of your lives. We are going to learn something about this milk now.

First of all look at it yourselves, and try to tell me something about it. What colour is it? It is **white.**

Let us compare it with this glass of water. Look, I will hold this penny behind the water. Can you see the penny? Yes.

Now I will hold it behind the glass of milk. Can you see it this time? No, we can see the penny through the water, but we cannot see it through the milk.

In this way lead up to the words **transparent** *and* **opaque,** *and let the children give other examples.*

Milk, then, is **opaque**; water is **transparent.**

2. But you told me just now that milk is white. Is water white too? No, water is not the same colour as milk.

What colour is it then?

This will probably puzzle the children at first; but a few samples of coloured water will soon set their minds at rest. A drop or two of red, black, and blue ink in a glass of water will explain all. **Water has no colour.**

3. Now suppose we notice next some point in which the water and the milk are alike.

Pour the water from one glass into another, and then do the same with the milk. Pour some of each on a slate, and show that, when the slate is tilted, they both flow about. They would run off and fall to the floor.

Let the children tell that tea and coffee, vinegar, oil, and ink would all **flow about in the same way.**

We have one name for all things that **flow about** like this. We call them **liquids.** So then water and milk, as well as tea and coffee, vinegar, oil, and ink, are all liquids, and we may say that **milk is a white, opaque liquid.**

4. *Next let one or two of the children close their eyes and taste the water and the milk. Ask them to tell the class how they knew one from the other.*

The **milk** is **sweet and pleasant to the taste,** but water has no taste at all.

Let them again close their eyes, and show that they can tell *the milk from the water quite as easily by smelling the two things.*

The **milk** has a **sweet, pleasant smell,** but water has no smell.

5. *Take two sheets of clean white paper. Pour a little milk on one, and some clean water on the other. Dry them both before the fire, and then let the children examine them.*

The milk leaves a greasy stain on the paper, but there is no stain from the water. Milk then is a **fatty** or **greasy liquid.** Let us see what we can learn about this fatty part of the milk.

If our eyes were sharp enough to see we should find that the milk is full of **tiny balls of fat.** We cannot see these little balls of fat floating about in the milk, but I have something else to show you which will explain it all.

6. *Show the milk which has been standing. Call attention to the* **thick yellow cream** *on the surface. Let the children tell what it is. Explain that this cream consists of* **those tiny balls of fat** *which have risen to the top of the milk. They always rise to the surface if the milk is allowed to stand still.*

Why do they rise to the top like this?

Put a small marble and a piece of cork the same size into a tumbler of water. Show that the marble sinks to the bottom: the cork floats on the top.

Why is this? The marble sinks **because it is heavy,** but the cork is **light,** and floats on the top.

Now tell me why those little balls of fat rise to the top of the milk, and form cream. They rise **because they are lighter** than the rest of the milk.

II. USES

1. *Point out that, as the farmer keeps cows for the sake of the milk they give, milk must be a very useful article indeed. Lead them to tell some of the uses to which it is put.*

We drink it; we put it in our tea, coffee, and cocoa: and we use it for making bread and milk, custards, and puddings.

When you were little babies what kind of food did you have? Milk.

Think of baby at home; it grows and gets stronger day by day, and yet it takes nothing but milk.

2. Milk, then, must be a very **satisfying, wholesome,** and **nourishing food.** It is the best of all food to give to sick people, young or old, because it is so easily digested.

Remind the children that the farmer uses some of the milk to feed the young calves, till they are old enough to feed upon grass as their mothers do. They take nothing but milk; but it makes them grow bigger and stronger day by day. Milk is one of the best of foods.

Elicit that butter and cheese are made from milk. Promise to tell how these are made in another lesson.

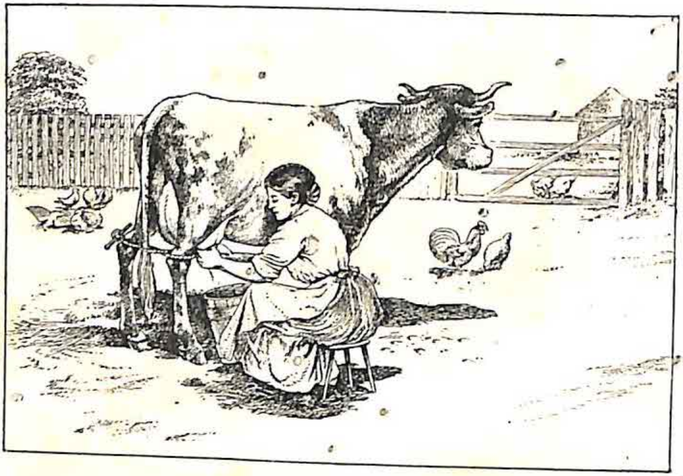
III. MILKING-TIME AT THE FARM

The children themselves should now be led to describe the milking-time. No doubt most of them have watched the process again and again in the farm-yard. Let the questions elicit the following points:—

1. The cows are milked regularly morning and evening. When the time comes for them to be milked, their **udder is swollen out** to a great size: it is **full of milk.** If they were not milked regularly it would **cause them great pain.** They stand very quietly while the milking goes on; when it is all over they feel easy and comfortable.

In the winter **they are milked in the stalls** in the cow-house as they stand. At other times in the year they are driven home from the meadows to the farm-yard, morning and evening, to be milked there.

2. *Point out the curious fact (for which there seems to be no reason but habit) that the cow-man or the milk-maid always places the three-legged stool* **on the right side of the cow,** *and milks from that side. Perhaps it is that the cows become used to them on that side, and might become restive if any one attempted to milk them on the other side. However it may be, it is a sort of law to always sit on the right side of the cow.*



3. *West Country children are all familiar with a contrivance called a* **spanner,** *which is always used whether the milking takes place in the cow-stalls or in the open farm-yard.*

It consists of a **hair rope** with **a ring** or **eye at one end,** and **a short bar at the other.** When milking-time comes the man slips the spanner round the handle of the pail, and so carries it over his shoulder. Then before commencing to milk the cow, he puts the rope round one of her legs, and twists it, in such a way as to get a turn of it round the tail. The end of the rope is then passed round the other leg, and the bar is pushed through the ring. In this way **the tail is kept still,** as the milking goes on. She cannot whisk it about.

Point out that the cow's tail is often very dirty, and this spanner saves the person who is milking from getting it whisked in his face. It also prevents any of the dried filth from falling off into the milk-pail.

4. *Tell that a good cow will give* **from eight to fourteen quarts of milk a day**—*more in the summer than in the winter. Some cows at certain times* **require to be milked at noon,** *as well as in the morning and evening.*

SUMMARY OF THE LESSON

1. Milk is a white opaque liquid.
2. Everything we cannot see through is opaque.
3. Milk is full of tiny balls of fat.
4. These balls of fat are lighter than the rest of the milk.
5. They rise to the top and form cream.
6. The cows are milked in the stalls in the winter time.

Lesson XXVII

BUTTER-MAKING

Articles for illustration: a tumbler of cream, a soda-water bottle, a piece of muslin, and one or two tumblers.

I. CLASS-ROOM WORK

1. *WARM a common soda-water bottle, and half fill it with fresh cream, which has been slightly warmed for the purpose. Cork the bottle up securely, and without entering into any explanation at present, hand it to one of the children, and instruct him how to shake it, so as to keep it constantly on the move.*

While Tom is shaking the bottle we will talk about our last lesson. You remember I poured some milk on a sheet of paper, and dried it before the fire. What did you notice when I showed you the paper afterwards? There was **a greasy stain on the paper.**

What did that tell us? It told us that the milk must be **a greasy liquid.**

Why is it greasy? Because it is full of **tiny balls of fat.**

2. What becomes of these balls of fat if the milk is allowed to stand? **They rise to the surface,** because they are lighter than the rest of the milk.

What becomes of them there? They float on the top of the milk, and form **cream.**

Show the rest of the cream in a tumbler. Notice that it is much thicker than milk, and that, instead of being white like milk, it is **slightly yellow in colour.**

Explain that this cream was skimmed off the top of some milk with a large flat spoon.

I had more than this at first, but I put some of it into that bottle. It is cream that Tom has been shaking up all this time. Suppose we have a look at it now.

3. *Stretch a piece of muslin over a tumbler, to form a sort of strainer, and pour out the contents of the bottle on it. Call attention to the liquid which drains through the muslin into the tumbler.*

Is it cream? No, it is **too thin for cream.**

Is it milk? No, it is **not white enough for milk.**

Stand the tumbler aside for the present, and draw attention to the bottle. Point out the **lump of solid yellow stuff** *in it. Break the bottle and turn it out.*

What is this yellow stuff? It is **butter.** Tom has made it by shaking up the cream in the bottle. So you see **cream comes from milk,** and **butter is made from cream.**

II. WORK IN THE DAIRY

1. *After explaining the principles of butter-making in this simple way, it would be well, where it is possible, for the children to pay a visit to the dairy at the farm—not, of course, during the progress of the work, for no dairy-maid would allow that,*

but at some quiet time, so that the appliances of the dairy might be examined and described.

On arriving at the place, call attention to the **large, cool, airy, spotlessly-clean room.** *Point out* **the wide stone shelves** *all round the walls, with the* **large flat earthenware pans** *on them filled with milk.* Why stone shelves?

2. *Elicit, from what the children already know, that* **milk would soon turn sour,** *and go bad, in a close warm place, or if it were kept in vessels that were not quite clean. This explains why the dairy must always be the* **coolest,** *the most* **spotlessly clean,** *and the* **most airy** *building on the farm.*

Notice the **dairy-maid** *too. She looks as clean and wholesome as the dairy itself.*

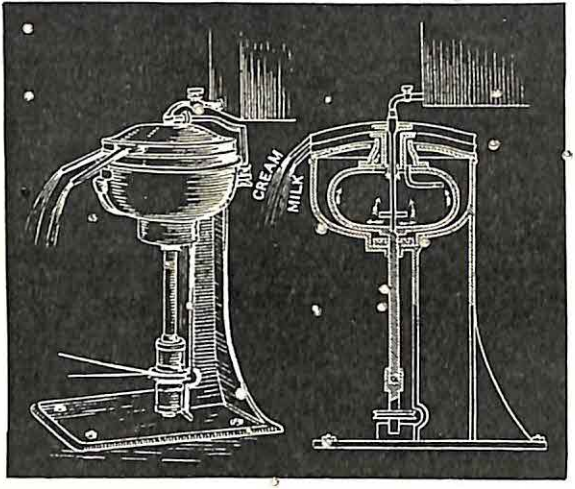
Refer to the milking-time in the farm-yard. Tell that, as pail after pail is filled with the rich warm milk, it is brought in here to the dairy.

GETTING THE CREAM.—*In all large dairies* **the cream separator** *is now used. Call attention to the machine, if there is one in the dairy, and explain that the first step in making the butter is to* **get the cream away from the milk.** *This is done very quickly by the* **cream separator.** *Describe in a few words the old-fashioned way of leaving the milk to stand in pans for hours (often for a whole day, and even longer) for the cream to rise to the top,* **so that it may be skimmed off.** *This is still done in small dairies, where only a little butter is made. In large dairies the work has to be done much more quickly.*

1. This clever machine, the cream separator, takes every particle of cream from the milk in a very few minutes, and there is **no need for the milk to stand,** for it is put into the machine just as it comes from the cow.

As the milk-pails are brought in one by one, the milk from them is **strained through a cloth sieve** into a great can. This is to get rid of hairs, pieces of straw, wood, or other things that sometimes fall into the pail, while the milking is going on.

2. There is a tap at the bottom of the can, and when this is turned on, the milk flows out of the can into an iron chamber at the top of the cream separator.



Inside this chamber are a number of **metal flaps or beaters.** These are made to whirl round rapidly by steam—so rapidly that the eye could not follow them. As they move round they set the milk in the chamber moving, and the cream, which is lighter than the rest, **is carried upwards to the surface.**

3. There is a tap in the top of the chamber, and through this the cream flows out into a vessel placed to receive it. The skim-milk flows out, too, but through a tap lower down, and all the time more and more fresh milk is coming in from the great can above.

In fact, the work of separating the cream goes on as rapidly as the fresh milk can flow in.

CHURNING THE BUTTER.—*Call attention to the churn now; describe it briefly, and show how it is worked.*

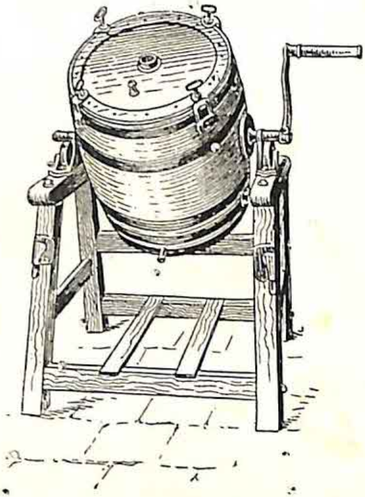
1. The cream, after being slightly[1] warmed, is poured into the **barrel of the churn**, and then the dairy-maid sets to work with her churning.

Refer to the experiment of shaking up the cream in the bottle.

What did you see when we emptied the bottle? A lump of butter and some liquid.

Explain that this is just what the dairy-maid finds when she works the churn.

Call attention to the **wooden flaps** *or* **beaters** *inside the churn. As the maid turns the handle, the cream inside dashes and splashes about against them, till at last butter is formed.*



CHURN USED IN THE ROYAL WINDSOR DAIRIES.

2. When the churning is over, and she allows the thin watery liquid to drain away, the **solid butter** is seen **all round the inside of the churn.**

Remind the children that the cream really consists of a mass of **little balls of fat**; *but when it rises* **it takes up with it some of the watery part of the milk.**

Explain that the object of churning the cream is to make these **little balls of fat free themselves from the watery liquid,** *and then they* **hold together to form a solid lump.**

3. *Let the children taste some of the liquid.* It does not taste like milk.

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[1] In the summer the temperature in the churn should be from 56° to 58° Fah.; in the winter from 60° to 62° Fah.

Think once more and tell me what this liquid really is. It is the cream with all the butter taken out of it. It is called **butter-milk.**

It needs no further description, for the children are, of course, quite familiar with it.

WORKING THE BUTTER.—When the butter is formed, it is taken out of the churn and put on a **cold stone table in the dairy,** but it is not yet ready for use.

1. *Explain that, although the butter can be taken out in solid lumps, it contains a great deal of the butter-milk. The dairy-maid has to get rid of all this watery liquid, for* **it quickly turns sour,** *and if any of it were left in,* **the butter would soon go rank.**

2. This is the most important part of the work. The butter must be **rolled,** and **pressed,** and **squeezed,** and

washed several times in clear spring water, till all the butter-milk is squeezed and washed out of it.

Tell that formerly all this squeezing, rolling, and pressing was done by the hands; but in the best dairies **the maid scarcely touches the butter with her hands** *now.* The work is all done by a machine called the **butter-worker.** *Let the children examine the machine if there is one.*

3. *Ask the maid to break a roll of butter across, and point out* **the rough granular appearance** *of the broken parts.*

This is known as the **grain of the butter.** The little balls of fat have **not been burst.** It is the great object of the butter-maker now **to preserve this grain.** Formerly, in working the butter by hand, a careless dairymaid would often **burst the little balls of fat.** When this was done, the butter showed no rough grain if it was broken; it had **a fatty greasy appearance like ointment.** Such butter **would not keep long.**

4. *This could be easily made clear to the class by melting a little butter in a spoon and leaving it to cool. The heating bursts the balls of fat, and the butter after cooling loses its granular appearance.*

N.B.—Salt is added to butter that is to be kept a long time.

Summary of the Lesson

1. The dairy must be kept cool and clean, and there must be plenty of fresh air, or the milk would soon go bad.

2. The cream is turned into butter in the churn.

3. The thin watery liquid left in the churn is butter-milk.

4. The butter must be rolled and pressed, and washed with cold spring water, to get rid of all the butter-milk.

5. When the balls of fat are not broken, the grain of the butter is kept.

Recapitulation in class, with Brown's picture of the Dairy.

Lesson XXVIII

CHEESE-MAKING

The following articles should be provided: some new and skim milk, a little essence of rennet, and two or three tumblers. Brown's picture of "Cheese-making."

Some time before the lesson, make a tumbler of fresh new milk blood warm, and then pour into it **about half a teaspoonful of the liquid rennet.** *Stir it well, cover it up to keep it warm, and leave it standing. Then treat another tumbler of skim milk in exactly the same way. Let the children see what is being done.*

I. Introduction

Introduce the lesson with a chat about the nature of milk, so far as it has been dealt with already. Proceed in some such way as this:—

Here is a glass of milk. What would happen if we allowed it to stand all day? The cream would rise to the top.

But I cannot see the cream. Where is it? It is floating about in the milk in tiny round balls of fat. **We cannot see it till it comes to the top.**

How can the cream be got from the milk? It has to be skimmed off the top.

What do we call the milk which is left behind, with all the cream taken out of it? We call it **skim-milk.**

What is done with the cream which is skimmed off? It is made into butter.

Quite right. Now, the one thing I want you to remember is that **the cream is in the milk,** although we cannot see it at first. I am next going to show you something else in the milk, **which at present you cannot see.**

II. CURDS AND WHEY

Ask one of the children now to fetch the other glass of milk which has been standing on the shelf.

Point out that this is now **a solid lump.** *We can turn the tumbler upside down. It will not flow out.*

Cut it out in little lumps, and place them in a saucer. Call upon the children to observe that **a clear thin liquid is now oozing out from the solid pieces** *that lie in the saucer.*

What has happened to the milk? Let us see.

Show the bottle of rennet, let the children taste a little of it on the tip of their finger. This liquid has **a sour taste.**

Tell the name of it—**rennet.**

It is this sour rennet that has made the change in the milk. We call the solid part **curd,** and the thin watery liquid that is oozing from it is **whey.**

Now produce the tumbler of skim-milk that was similarly treated. Tell what it is, and let the children say why it is so called. This is now a solid mass like the other. Cut it out as before that the children may see.

This skim-milk has had all the cream taken out of it Yet it separates into curds and whey just as the new milk did.

What does this prove? It proves that **the curds do not come from the cream.**

Of course it does. So now we are sure of two things. We know that milk contains cream, although it cannot be seen till it rises to the surface; and that it also contains something else, **which we cannot see till it is curdled.**

The cream, you know, is made into butter. What do you think we get from the curd of the milk? I will tell you; **the curd is made into cheese.**

III. HOW CHEESE IS MADE

Every farm-house has its dairy, where a certain quantity of butter, more or less, is regularly made. But cheese-making is not so universal in all farms.

In districts where it is possible, the children should be taken to the farm as before. Where this cannot be done, the work must be described with the help of the picture.

Needless to say, in no case are cheese-making and butter-making going on at the same time in the same dairy. In many of the **great cheese-farms** *the work is done in a special house known as* **the cheese-house.**

On the way there the teacher would do well to have a little chat about the nature of this peculiar liquid—**rennet**—*what it is, and where it comes from.*

When a calf is killed, **its stomach**—the bag which holds the food—is saved. It looks then something like **a piece of tripe.** It is salted, and hung up in a warm place to dry, and there it hangs, perhaps for a year, till it is more **like a piece of thick dry skin** than anything else.

It is then soaked in boiling water, and when the liquor is cool, it is strained off and bottled. **This liquor is the rennet which the farmer uses.** It has a sour taste, and is always used for curdling milk to make cheese. **Half-a-pint of rennet will turn one hundred gallons of milk into curds and whey.**

N.B.—*The farmer does not make his own rennet. He buys the liquor ready-made for his use. Still the children should know what it is, and how it is made.*

1. FORMING THE CURD.—*The first thing to attract the attention of the children on entering the building will no doubt be the great tub which stands in the middle of the stone floor. Proceed to describe the work as follows:—*

The evening's milk is put into this great tub, where it is kept cool all night, and in the summer-time it is **frequently stirred** to prevent the cream from rising. The next morning it is **warmed,**[1] **the fresh morning's milk is added to it,** and then the two are well mixed.

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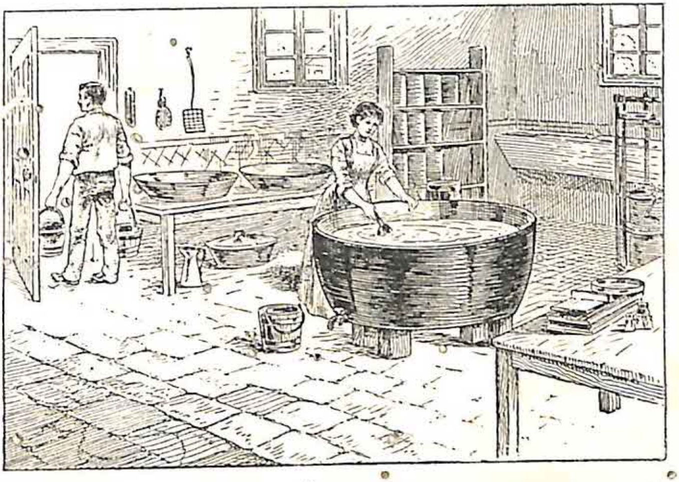
[1] In the summer time the temperature is raised to about 78° Fah., and in the winter to about 85° Fah., before the rennet is added.

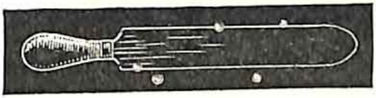
The **rennet is now poured into the milk** from a bowl, and with the same bowl the mixture is well stirred for about ten minutes. **The bowl is often left floating** on the milk after the stirring, and a cover is put over the tub to keep the mixture warm.



It is then left to stand **until the bowl can be lifted out clean,** that is, without any of the curd sticking to its sides.

The tub now contains a white pulpy mass, solid from top to bottom.

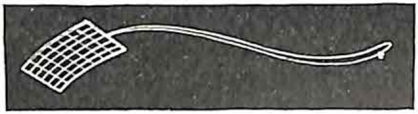
2. CUTTING AND BREAKING THE CURD.—*Show the* **curd-cutter,** *and proceed :—*



This long knife is drawn through the thick mass in the tub, **making parallel cuts in it,** after which it is drawn through again in a similar way, **at right**

angles to these cuts, and so **the mass is cut up into long square-topped pieces.**

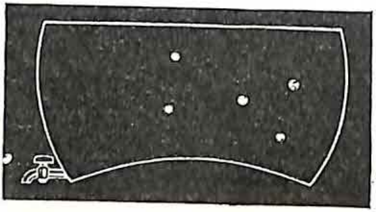
Show the **curd-breaker** *now, and tell how it is used for breaking up the curd into still smaller pieces.*



This done, the broken curd lies in a heap of brick-shaped pieces on the bottom of the tub, where it is left to drain.

After a time it is found that a considerable quantity of thin clear liquid has oozed out from the solid part. The milk has at last been separated into **curds and whey.** The curd lies piled up in a heap in the middle, and the whey has drained down into the lowest part of the tub all round.

3. SCALDING AND SEPARATING THE CURD.—Some of this whey is now taken out in pails, heated, and poured back again, until the contents of the tub are at the required heat.[1]



SECTION OF TUB—SHOWING THE RAISED BOTTOM.

The curd is heated or scalded in this way twice, and after each scalding it is stirred and left covered for a time. The second resting-time lasts about half an hour, and is called **cooking the curd.**

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[1] The first scalding brings the temperature to about 85° Fah., the second raises it till it reaches from 94° to 97° Fah., and this is the same for winter and summer.

This cooking turns the curd into one mass again.

A fine strainer is now placed under the tap at the bottom of the tub, and **the whey is all drawn off.** This done, the curd after being again cut into blocks, is heaped up in the middle of the tub, covered with a cloth, and left to drain and become firm. Sometimes a weighted board is placed on the top to aid in this operation.

4. COOLING AND RIPENING THE CURD.—The blocks are now **cut into strips** and **laid on the cooler,** where the curd cools and ripens after a time.

A cheese-maker knows by the touch, smell, and appearance of the curd, when it is ripe and fit to work.

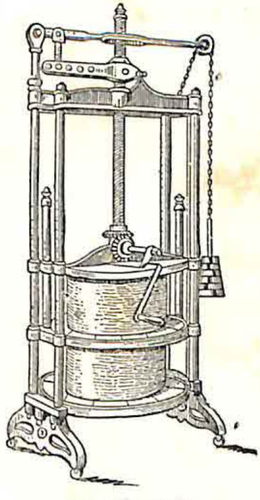
5. MILLING AND SALTING THE CURD.—*Show and describe the* **curd-mill** *now.*

The ripe curd is cut up into pieces **about the size of a walnut** by the curd-mill, and powdered salt is thoroughly mixed with it. One pound of salt is used to 45 pounds of curd, or 1¼ lbs. to 56 gallons of milk.

Compare this with the salting of butter. It must be salted to make it keep good. **The curd would not keep long without salt.**

6. PRESSING AND DRYING.—*Pass on next to notice the* **cheese-vat,** *and the* **cheese-press.**

Explain that the **vat** *is for* **moulding the cheese into the proper shape,** *and the* **press** *is to* **squeeze out any of the moisture** *that may still be left in it.*



CHEESE-PRESS.

(*a*) The salted curd is pressed by the hands into a vat, which is first lined with linen cloth, and the vat itself is then placed in the cheese-press. There are **holes all round the bottom of the vat,** and as it is being pressed, the whey that remains in the curd **runs out through these holes.**

(*b*) **Every morning for three days** the cheese is taken out of the vat, and the cloths are changed. It is then put into the vat and pressed again, the pressure being increased each time.

At last the cheese is taken out of the vat, bandaged tightly with a cloth, and taken to a large dry, airy room, known as **the cheese-room.** Here it is placed with others on a shelf, and for the first two weeks it is **turned once** every day. After that the turning takes place every few days, until at last **the cheese gradually gets quite dry** and ready for market.

N.B.—*This is the process of making Cheddar Cheese, and it has been chosen, because that is one of the most widely made cheeses. The other makes differ either in the amount of cream used, the temperature, or the cutting and pressing. Stilton cheese is not pressed.*

SUMMARY OF THE LESSON

1. Rennet curdles milk. It changes the milk into curds and whey.

2. Rennet is made from the stomach of the calf.

3. Cheese is made from the curd. Whey is good to drink.

4. The whey must be all pressed out of the curd or the cheese would go bad.

5. Salt is put with the cheese to make it keep.

Lesson XXIX

BEES (FIRST LESSON)

Provide some honey, a specimen of honey-comb, a few fresh-gathered flowers, a large well-developed flower of some sort for dissection, a living bee under an inverted tumbler.

Brown's picture of "Bees."

I. A Pot of Honey

1. *Show the specimen of honey, and lead the children to examine and describe it. Their eyes will tell them that it is* **a thick kind of liquid,** *of a* **bright, golden-yellow colour.** *If they smell it, they find that it has a sweet, delicious smell; and they know that if they put some of it into their mouths, it tastes sweet—very much sweeter than sugar. It is* **a rich, sweet juice or syrup.**

2. *Tell that this delicious honey comes from the flowers.*

In most flowers there is, at the very bottom of the flower-cup, a little bag, called **the honey gland,** which contains a tiny drop of sweet juice, which we call **nectar.**

Have a few fresh-gathered flowers for the lesson. Hand some of these round the class, and help the children to find for themselves the honey-gland and the sweet nectar in it. This will rouse their curiosity to learn how the honey is actually obtained.

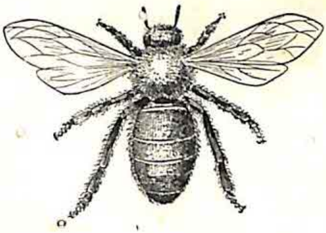
II. The Bee and its Habits

1. The honey, then, comes from the flowers, but remember we could never get it ourselves. This is the clever little thing which gathers all the honey.

Show, if possible, a living bee under a glass.

Do you know what it is? It is **a bee.**

Look at it and tell me what it is like. It is something like **a very large fly.**



2. *Show a picture of the bee, and lead the children to point out the peculiar form of the body. It is made up of three parts—first* **the head,** *then* **the chest,** *and then* **a big part behind the chest.** *Point out that these three parts are almost separated from one another. The body looks as if it were* **cut**

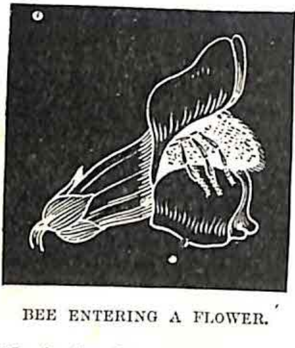
through in two places. *In this way lead up to the name* **in-sect.**

Point out the **two pairs** *of delicate, gauzy* **wings.** *Flies have only one pair of wings. Notice too the* **six legs,** *three on each side. Tell that* **all insects have six legs.** *Call attention to* **the fine hairs** *which cover the whole of the body and legs.*

3. Of course you have all seen the bees flying about in the fields and gardens. Have you ever noticed where they go, and what they do? They keep flying about from one flower to another.

Lead the children to describe, as far as they can, the visits of the bee to the flowers. Picture it alighting on a flower and **forcing its way into the very bottom of the flower-cup.** *After a time it comes out again, and flies away to some other flower to do the same. Why does it visit the flowers in this way?*

4. This clever little insect is searching for honey; that is why it pushes its way right into the middle of the flower. It knows too that **there is no sweet nectar in some flowers,** and it never pays them a visit. Whenever it alights upon a flower, and pushes its way in, it is busy all the time **sucking up the sweet juice,** and it goes from flower to flower till it has got as much as it wants.


BEE ENTERING A FLOWER.

Tell that the bees do not eat this sweet syrup themselves. They only suck it up **into a little bag in their bodies,** *and carry it away to their homes. When they get there they give it all up, and* **it is stored away,** *to serve as food for them in the winter when all the flowers are gone.*

5. *Show next a well-developed flower of some kind. Call*

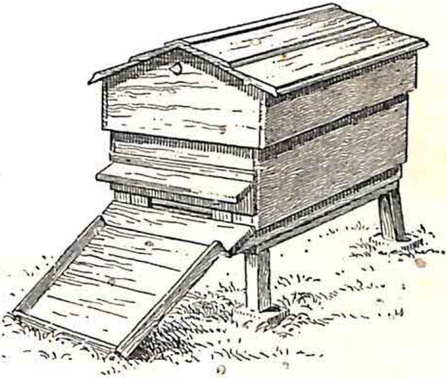
attention to the long slender stalks in the middle of the flower, with a little knob perched on the top of each one. No names need be given for the present. Let the children touch them, and point out **the yellow dust,** *which adheres to the finger when they take it away. This is* **the pollen of the flowers.**

Tell that the **bees collect this pollen** *also from the flowers, and carry it home. They use it* **to feed their young ones.** *It has been called* **bee-bread.**

Remind the children that we never see bees flying about in the winter time. Explain that there are no flowers then, and the bees remain snug and warm in their homes, till the cold weather has all gone.

III. THE BEE-HIVE AND THE COMB

1. We have spoken several times of the bees' home. Now I want you all to tell me what kind of home it is, and everything you can remember about it.



THE HIVE.

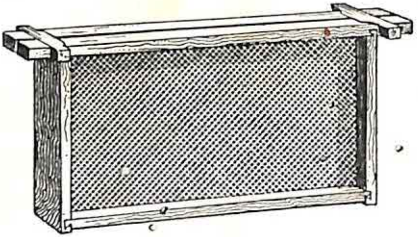
In this way elicit from the children's own observation as follows:—

People who keep bees give them a little house to live in. It is called **a bee-hive.** The hives are placed on low stands in the orchard or garden—always near the flowers. In each little house immense numbers of bees live together. There is a sloping board near the bottom of the hive in front, **for the bees to alight on,** and above this is the **entrance porch.** The actual doorway or entrance is **a narrow slit,** cut out of the floor-board under this porch. Through this the bees go in and out.

Show the bee-hive in the picture, or draw a sketch of one on the blackboard, as the children describe it.

2. *Show now a specimen of the* **honey-comb,** *calling attention to the* **six-sided cells.** *Tell that, as soon as the bees get settled in their hive, they commence to build these little boxes or cells. We call the wall of little boxes the* **honey-comb.** *They always build their boxes the same shape, with* **six sides.** *They build them with wax* **(bees'-wax),** *which they make for themselves from the food which they have eaten. Show a specimen of bees'-wax.*

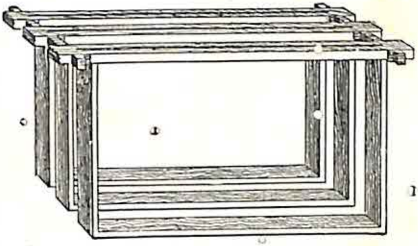
3. The hive is provided with a number of movable oblong wooden frames, usually ten, which hang down side by side, exactly $\frac{5}{8}$ of an inch apart. Each frame is $\frac{7}{8}$ of an inch across the top, and is fitted with a **wall of fine wire gauze.** There is thus exactly an inch and a half space between wall and wall. The bees build their cells on both sides of these hanging walls, beginning at the top and working downwards.



4. *Call attention once more to the honey-comb. Open one of the cells, and show* **the honey inside.** *Tell that these clever little insects make their honey, and store it away in these* **boxes**

or cells, *just as mother makes jam, and stores it away in* **jam-pots** *for use in the winter, when she cannot get any fresh fruit.*

People who keep bees want the honey for themselves, so when the bees have filled their cells their masters take away as much as they want, and leave them only just enough to keep them till the winter is over.



Explain that the object of these movable frames is to enable the bee-keeper to take away the combs when they are full of honey. Formerly people knew no better way of doing this than by smothering the bees with smoke.

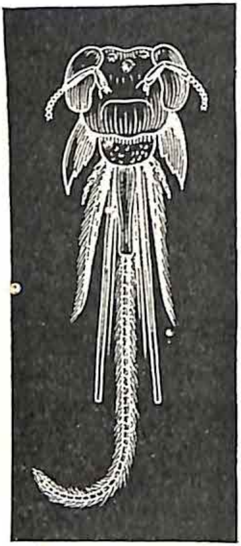
IV. THE BUSY BEES AT WORK

1. THEIR WORK IN THE HIVE.—The first work which the bees have to do in their new hive is to build the cells. They make them of wax, and they prepare the wax itself from the food which they have eaten. When they have eaten their fill, **they hang themselves up** on the frames and there remain for a long time. While they hang there, the wax squeezes out through **six little pockets** or **slits** between the joints on the under side of the body, and then they knead it up with their jaws, till it is fit for the work of cell-building.

Refer once more to the comb itself and its **six-sided cells,** *and show that with such an arrangement the greatest possible number of cells can be built close together,* **without wasting the wax** *or* **losing space.**

2. THEIR WORK OUTSIDE.

(*a*) **Gathering the Honey.**—The honey is collected from the flowers by means of **the tongue,** which is fitted in a wonderful way for its work. It is **very long,** and is **covered with hairs like a brush.** The bee can push this long tongue down to the very bottom of the flower, and lick out all the sweet juice that is there. It swallows this juice, which goes into **a sort of stomach** called **the honey-bag.** When this bag is full the worker returns to the hive, and squeezes it all out into one of the cells of the comb, carefully sealing the mouth of the cell up with wax as soon as it is filled with honey.



BEE'S TONGUE.

(*b*) **Gathering pollen for bee-bread.**—*Remind the children of the other substance*—**pollen**—*which the bees carry home to the hive. Have ready to hand one or two well-developed flowers for inspection. Point out where the pollen is stored,* **in the little cases, at the top of the slender stalks** *in the middle of the flower. Let the children touch one of them with their finger, and they will find some of the powdery dust sticking to it.*

Show that when the bee enters the flower to get to the sweet nectar at the bottom of the flower-cup, it must push aside these pollen cases and **shake out the yellow dust** *from them. The bee soon becomes* **as dusty as a miller,** *for it gets covered all over with this* **pollen.**

3. *Proceed next to examine the structure of the bee, and show how well it is fitted for collecting up this pollen, and carrying it home for the little ones.*

The body itself is **covered** all over **with short hairs.** The pollen collects on this hairy body **better than it would** on a smooth surface.

The **legs** too are very **hairy.** The bee uses its **front**

legs as **brushes** to brush off the pollen from its body. But what does it do with the pollen it brushes off?

Show a picture or a drawing of the bee's third leg. Point out the hollow in the outside of the thigh, with **the strong, stiff hairs standing up all round it.** *This is* **a little basket.** *The pollen is brushed off into these little* **thigh pockets** *or* **baskets,** *and when they are filled the bee flies away home to the hive, and stores it in the cells, mixed with honey, to make bee-bread for the young ones.*

SUMMARY OF THE LESSON

1. There is honey in the bottom of most flowers.
2. The bee sucks up this honey with its long tongue.
3. The yellow dust in the flowers makes bee-bread to feed the young bees.
4. Thousands of bees live together in the hive.
5. They build their honeycombs in the hive with wax.
6. They make hanging walls side by side with little cells or boxes in them to hold the honey.

Lesson XXX

BEES (SECOND LESSON)

Provide some honey, a specimen of the honey-comb, and Brown's pictures of the queen, worker, and drone, the bee's sting, a bee entering a flower, and the bee-hive; see Lesson XXIX.

I. INTRODUCTION

1. *SHOW the specimen of honey, and proceed at once to introduce the new subject by eliciting from the class the leading facts of the teaching in the former lesson. This honey came from the flowers—the bees collected it, and stored it away in their hive. In the hive they make cells of wax to hold the honey which they gather. The wall of cells is called the honey-comb. The bees collect pollen from the flowers, as well as honey, and store it in the*

cells to feed their young. We call it bee-bread. Why do the bees store up honey in the hive?

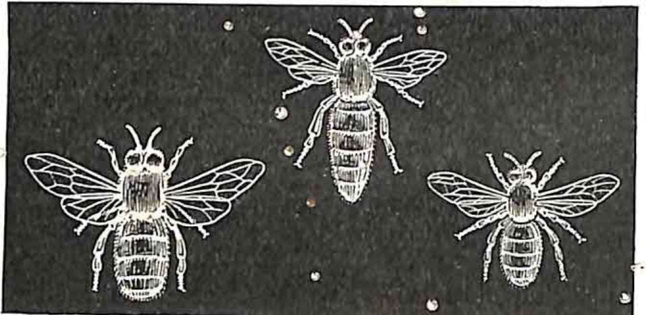
2. *Turn next to the bee itself. It is an insect. What does that mean? How many legs has it? How many wings? Have all insects six legs and two pairs of wings?*

The teacher should carefully avoid telling anything himself, except where the children fail; and after refreshing their memory in this way point by point, he would proceed with the lesson as follows:—

II. Kinds of Bees

Remind the children that we often speak of the bees as **busy bees.** *Why? Because* **they work so hard.** *Tell that all the bees in the hive are not* **busy bees; they do not all work.**

There are three kinds of bees in the hive — **the workers, the queen-bee,** and **the drones.** *Show pictures of these.*



DRONE. QUEEN. WORKER.

1. The Workers.—These are the real busy bees, for they do all the work. They **make the wax,** and **build the cells** with it; they **gather honey** and **pollen** from the flowers, and **store** both **away in the cells**; and **they nurse** and **feed** the young ones. The workers are the smallest of the three kinds.

2. THE QUEEN.—There is **one queen** in every hive. She is the mother of all the rest, and they pay her great respect. She does no work, and she never leaves the hive, for **she cannot fly far.**

Compare the queen-bee with the worker in the picture. Notice that not only is her **body much larger,** *but her* **wings are much shorter** *than those of the working bee. This will explain why she stays at home.*

The queen, as the mother of all the rest, lays eggs from time to time. She sometimes **lays two thousand eggs in one day. Some of the cells** in the comb are always set apart as nests **to receive the queen's eggs,** and she lays **one egg in each cell.** When the young ones are hatched they begin life in this little nest.

3. THE DRONES.—These are the male bees. They are much bigger than the workers, but **they do no work themselves.** There are very few drones in the hive. A well-stocked hive usually contains from 30,000 to 50,000 working bees, but there are seldom more than a few hundred drones. They spend a roving sort of life all through the summer, living on the honey which they sip from the flowers, but **doing nothing for the general good.**

Remind the children that these drones are like some **idle useless people,** *who want to live on the work of others, and are* **too lazy to work for themselves.** *We often call people of this kind* **lazy drones.** *Tell that the workers—* **the busy bees**—*seem to object to have these idle drones living amongst them.* **They drive them away and kill them,** *even in the summer-time; but when the autumn comes, and the flowers are gone, they all in a body set upon those that are left, and* **sting them to death.** *They make sure they will have no idle drones in their hive, to live all the winter on what they have stored up by their hard work during the summer.*

It is a curious thing that **only the workers have stings;** the drone has no sting—it cannot defend itself. The sting is placed at the end of the body, and consists of a

pair of sharp, barbed darts, which fit into a sheath when not in use. They are **hollow tubes,** and are supplied with **poison** from **a poison bag** near their root. Bees, wasps, and hornets all have stings of this kind. When they sting, not only does the sharp point pierce the flesh, but **poison flows out into the wound** from these hollow tubes. It is the poison that does the mischief.

III. SWARMING

1. A LARGE FAMILY.—*Refer to the large number of eggs which the queen-bee lays, and ask what will become of these eggs. Point out that as the hive is already very full, it will soon be overcrowded, when the young bees begin to come. Then by using the illustration of brothers and sisters leaving home, lead the children to say what is best to be done in such a case.*

The young bees must some day find a home for themselves elsewhere.

2. ONE HOME, ONE QUEEN.—What must there be in every hive? A queen-bee.

Tell that amongst the thousands of these young bees there is always another queen hatched. The bees take special care of her, and give her special food.

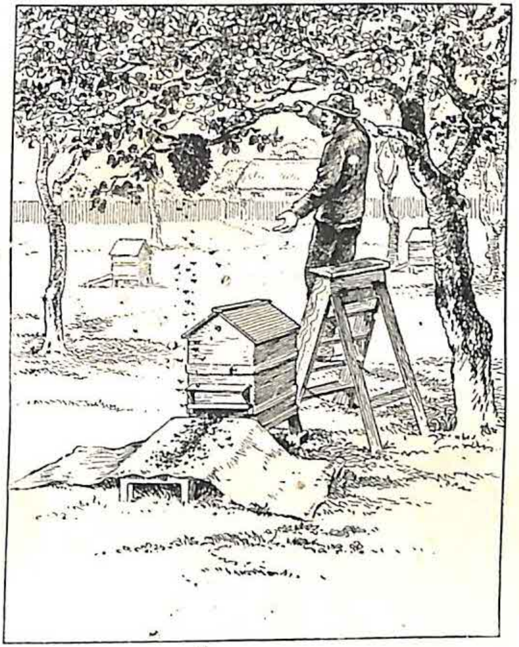
So then in course of time there are two queen-bees in the same hive—two queens in one country. That could never last for long. **One of them must turn out.** So out that one goes, and a large number of the other bees go with her. **They follow, to find with her a new home.**

3. CLUSTERING.—*Remind the children of the queen's small wings. She cannot fly far: she must soon rest.*

She rests **on a branch of a tree,** sometimes near the ground, sometimes higher up. The other bees will not leave her. **They swarm around her,** crawling over one another, and humming all the while. Soon all are settled on the branch in a heap. There are thousands of them. **They look like an immense bunch of grapes** as they hang there.

4. HIVING THE SWARM.—Now is the time for the bee-keeper to capture them.

Tell how it is done. Describe his dress. He usually ties a head-covering[1] of fine netting round his neck and over his collar.



He wears gloves, ties his coat-sleeves tightly round his wrists, and the bottoms of his trousers as tightly round his ankles.

Why all this care? **The bees get angry** when they are moved, and **will sting,** and so he takes care they shall not come near his flesh.

He first places a hive on the ground, as near as he can to the swarm, with some honey or sugar-syrup in it. Then he spreads a sheet in front of the hive, with one end resting on the sloping board at the entrance.

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[1] Some bee-keepers become so deft in managing the bees that they fearlessly hive the swarm without any covering. See the man in the picture.

That done he gets above the branch to which the bees are clinging, and **gently shakes it. The swarm quietly drop into the sheet,** and quickly make their way into the hive to get to the sweet honey or syrup.

As soon as they are settled, he takes the hive away, and places it gently on the stand prepared for it.

The bees are quite content in their new home, **if the queen-bee is with them**; but if by any chance, she is missing, they will fly off, find her and swarm again.

Some bee-keepers **cut the branch off,** if they can do so without jarring, **carry it to the hive,** turn out the swarm on the sheet, and leave them to enter it in search of the syrup.

Promise to take the children to see a swarm of bees hived at the first opportunity.

The best time for hiving a swarm is hinted at in the old well-known lines:—

A swarm of bees in May is worth a load of hay;
A swarm of bees in June is worth a silver spoon;
But a swarm of bees in July is hardly ever worth a fly.

N.B.—*Bee-keeping will be dealt with again in a later stage, when other methods of hiving will be described.*

SUMMARY OF THE LESSON

1. There are three kinds of bees in the hive—the Queen, the Drones, and the Workers.
2. The Drones are lazy; they do no work.
3. The Workers build the cells and gather honey.
4. The Queen is the mother of all. She lays eggs in some of the cells.
5. When the eggs are hatched there is sure to be another queen among the young bees.
6. When a queen bee leaves the hive, large numbers of the others follow her.
7. They swarm round her wherever she goes.

LESSONS ON THE SEASONS

Lesson XXXI

SUMMER (A RAMBLE)

This lesson should be given during the hay-making time, say the early part of July, and in preparation for it the children should be called upon to observe for themselves, and report to teacher from time to time as before.

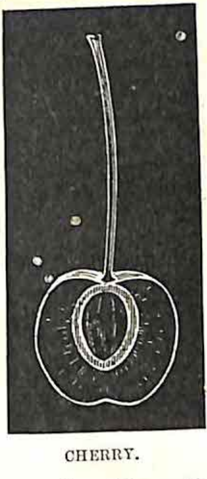
I. GARDENS GAY; FRUITS ABUNDANT

1. *Choose a typical summer afternoon for the ramble, and call attention to the gardens and orchards on the way.* The garden is now in the fulness of its beauty—gay with the **rich bright colours of the flowers,** and the air all round is full of their **sweet perfumes.**

In the orchards the **apple, pear,** and **plum trees** are loaded with fruit; but the fruit is still green and unfit to eat. **The warm sun will ripen it in time.**

2. *Lead the children to tell that at this time of the year, while we are waiting for the apples, pears, and plums, we get abundance of* **ripe cherries, gooseberries, currants, strawberries,** *and* **raspberries.**

Let them describe each of these fruits (in a simple way of course and without requiring details of structure). They should also know the kind of plant on which each one grows.



CHERRY.

3. THE CHERRY.—*Show the fruit, open it, break the stone, and call attention to the kernel inside.* **This kernel is the seed.** We call

the cherry **a stone fruit**, because its seed is inside this **hard stony case**, in the middle of the sweet juicy flesh or pulp which we eat.

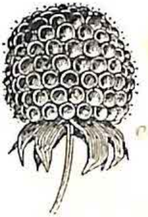
Ask the children to name other fruits of the same kind.

4. Currants and Gooseberries.—*Show the fruit, break the skin, and notice that the watery juice or pulp at once flows out.* The little seeds are **in the middle of this juice.** Fruit of this kind is called **a berry.** Red, white, and black currants, as well as gooseberries, are all berries.

GOOSEBERRY.

5. The Raspberry.—*Show this fruit. Dissect it, and point out that it is really* **a cluster of tiny stone fruits.** *There is* **one seed in the middle of each** *of these little fruits.*

This fruit, in spite of its name raspberry, **is not a real berry.** It is not at all like a currant or a gooseberry.



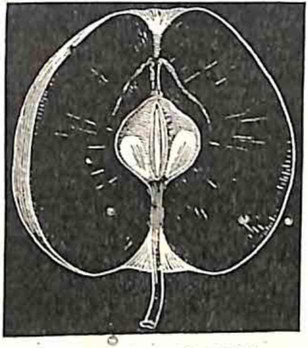
RASPBERRY.

STRAWBERRY.

6. The Strawberry. — *Show this fruit. Cut it through, and point out that it has neither a stone nor seeds in the middle.* **The seeds of the strawberry grow on the outside of the fruit.** This fruit is **not a true berry** in spite of its name.

7. Apples and Pears.—*Pluck an apple, cut it open, and show the* **pips or seeds** *in the middle of this fruit.* The

seeds of apples and pears are found **in a sort of case,** called **the core,** in the middle of the fruit.



SECTION OF AN APPLE.

Take this opportunity of warning the children against eating unripe fruit of any kind.

II. THE FARMER'S CROPS GROW

1. THE GROWING CORN.—*The state of the corn crops at any particular period depends upon the locality. But in most districts in the Midlands and the South the flowering time is now over, and the ear is formed.*

Where this is the case compare the ears of wheat, barley, and oats.

Notice that all are **still green.** *Notice too how tall the corn-plants have grown, and call attention to the* **waving, rustling motion of the corn** *in the breeze.*

2. *Tell that the corn is now* **full-grown.** *Press a stick into the ground, and observe how hard and dry the soil is.*

The corn will get no more moisture from the ground; it will grow no more. But as it waves to and fro, **the bright hot sun will ripen it,** and when it is ripe it will be fit to cut.

Notice too the brilliant red poppies which peep up among the green ears.

In districts where the corn crop is later, the ear will probably be in flower just now. If so, call attention to **the flower.**

1. THE HAY CROPS.—*Pass on now to the hay meadows, where the hay-makers are at work. Let the children watch the operations going on. If the weather has been favourable, all the various processes may probably be seen in the adjacent fields.*

Call attention to the **mowing machine,** without of course entering into details as to its structure and working for the present.

Watch it at its work. Notice how the slanting **track-board** *carries the grass in* **swathes,** *as it is cut by the knives, and* **throws them aside one after another.**

2. What will happen to the grass now? The cut swathes will **lie where they are to dry.**

Pass on now into another field where most likely **the hay-tedder** *is at work* **turning the swathes.** *Notice how the long tines or teeth* **catch the grass and toss it over,** *as the machine moves along.*

Tell that formerly this part of the work was done by men with forks. This useful machine does it more quickly.[1]

3. *Take up a handful of the hay, and compare it with some of the fresh-cut grass from the other field.*

The hay **rustles** and **shines.** There is a **bloom on it.** It is **not so heavy** as the fresh-cut grass, and **not so green.**

Lead the children to think out the reason why it is not so heavy.

The **moisture has been dried out of it.**

4. How long will the farmer let the hay lie on the ground? Till it is properly dried.

Explain that the hay **must not be allowed to get too dry.** *Call attention to* **the horse-rake,** *which is at work gathering up the hay in long* **wind-rows,** *ready for the men to pile in* **cocks** *or* **pooks.**

The reason for piling it in these cocks or pooks is **to prevent the sun from drying it too much.**

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[1] Some farmers object to the hay-tedder, because in very dry seasons it threshes and scatters the valuable seeds.

Notice that **the hay-cocks are all placed in rows,** *so that the waggon may pass between them.*

5. Now let us go into the next field, where they are carting the hay away to the **hay-barton** in the farm-yard.

Call attention to the **raids** *or* **hay-ladders** *on the waggon. Watch the men*—**the pitchers** *they are called—one on each side of the waggon, lifting up the hay with long forks, while the* **loader in the waggon** *takes it from them, and* **stacks it.**

Point to the other waggon with its heaped-up load of hay, securely tied with cords passing from corner to corner and over the top.

This is already on the way home. Those men and boys on the top think it is very jolly to ride on a load of hay.

III. The Trees are crowded with Leaves

1. *Notice the trees everywhere, with their dense covering of leaves overhead.* The leaves are so thick on the trees that **the sun cannot shine through them.** It is the thick mass of leaves that makes **a cool refreshing shade,** even when the sun is very hot.

Proceed to gather specimens of as many leaves as possible—e.g. **ash, beech, birch, chestnut, elm, hazel, hawthorn, lime, oak, poplar, sycamore,** *and* **willow.**

2. *As each leaf is plucked, tell its name, and let the children examine it, so that they may see for themselves that* **each tree has its own particular kind of leaf**—*and that the leaf of one is not like the leaf of another.*

Every country boy and girl ought to be able to name at a glance the leaves of all our common trees, and to tell each tree by its leaf. Let us sit down here, and examine these leaves one by one.

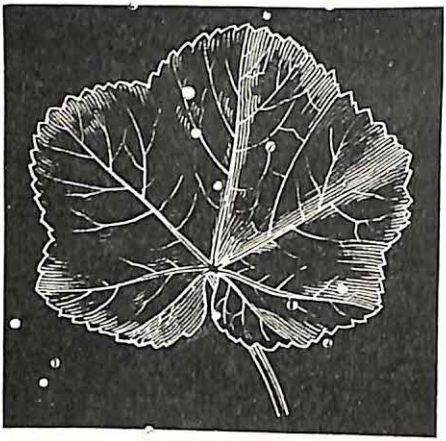
This must be done in the simplest way, and without any attempt to burden the children with unnecessary names. Let them, as far as possible, make their own observations, the teacher giving the necessary directions to **look at—look through—feel the leaves,** *and so on.*

3. *They observe that all the leaves before them are green, although some are lighter in shade than others; and they also notice that the* **under side of every leaf is lighter** *than the upper.*

While dealing with the colour of the leaves, endeavour to slip in a leaf of the **red** *or* **copper-beech,** *if possible.* Leaves as a rule are green, but here you see is **a red leaf.**

ROSE LEAF.

4. *Lead them to notice next the two essential parts of all these leaves*—the **blade** and the **foot-stalk.** *Show that some leaves have* **a single blade**; *others* **more than one.**



MALLOW LEAF.

Separate the specimens into two groups—**simple leaves, compound leaves.**

5. *Pass on next to deal with the great diversity in* **shape** *between one leaf and another, as shown by the specimens; and point out that one leaf has a* **smooth edge,** *another is*

toothed at the edge *like the edge of a saw, another is* **deeply notched** *or* **indented,** *and so on.*

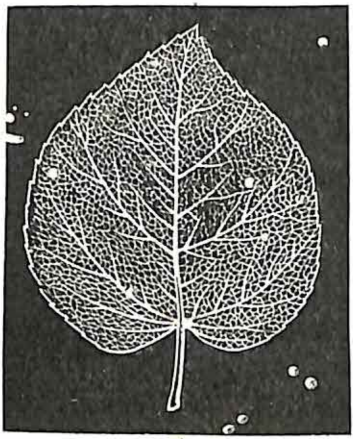
VIRGINIA CREEPER.

HORSE-CHESTNUT.

6. *There is another difference to be noted, and that can be discovered by taking the leaves in the hand.* One leaf is **smooth to the touch ;** another has a **rough hairy surface.**

7. *Now lastly let the children hold the leaves up to the light one by one. As they try to look through them, they discover in each one* a **network of very fine lines.** There is a **thicker coarser line** running through the **middle of the blade,** and from this others branch out on either side. These are **the ribs of the leaf ;** the very fine lines are called **veins.**

Notice that in this respect all the leaves before us are alike.



LIME LEAF.

8. *Let the children now name as many of the leaves as they can, the teacher assisting of course when they fail.*

It would be advisable to let them take away with them a specimen of each for future reference. They **can be easily dried** *by spreading them out carefully* **on sheets of blotting-paper between two stout cardboards,** *and placing a heavy weight on them.*

When properly dried they should be taken out, **named,** *and* **fixed on paper,** *which can then be* **pricked** *and* **sewn round.**

Thus treated they will serve not only as **specimens for future reference,** *but also for the children* **to copy in the drawing lesson.**

SUMMARY OF THE LESSON

1. Summer is the time for flowers and fruit.
2. The corn grows tall. It waves about in the breeze.
3. The hay-crops are got in.
4. The trees are crowded with leaves.
5. There are many sorts of leaves.

Recapitulate in class with the help of Brown's pictures —(1) Summer Fruits, and (2) Haymaking.

Lesson XXXII

HARVEST-TIME

Brown's picture of Harvest-time, with details of the reaping-machine, will be required for recapitulation in school.

I.—INTRODUCTION

On all arable farms this is of course the most important operation of the year. Wherever possible, the children should be taken into the fields to see the work going on, so that each step may be explained.

On the way call attention to the appearance of the corn in the fields. Remind the children that in the early spring they saw *it peeping up out of the ground* **like little blades of green grass**; *that they watched it grow* **taller and stronger** *day by day, till at last they saw* **the green ears forming** *at the top of the stalk.*

The **ears** are now **plump and full,** and of a **rich golden brown colour**; and even the **stalks are no longer green,** but yellow and shiny-looking. **The corn is ripe and fit to cut.**

II. CUTTING

1. *Watch the reaping-machine at its work. In some districts the* **side-delivery machine** *is used; but* **the binder** *is rapidly coming into favour on all the larger farms.*

2. *The machine with its* **two horses in front,** *and the* **driver quietly seated** *on his box, although a familiar sight to most of the children, will acquire a new interest, if teacher is by to explain what happens, as it moves through the standing corn.*

Call attention to the position of **the knife,** *which works rapidly from side to side, as the machine moves on.* **It is this knife which does the cutting.**

The children should have an opportunity later on of examining the knife for themselves.

3. *Point out* **the four rakes** *or* **arms,** *which whirl round and round with the onward movement of the machine. Compare them in their action with the revolving arms of* **a hay-tedder.**

These rakes **catch the corn** as they whirl round, **press it against the knife,** then **sweep it on,** as it is cut, to a small platform behind, and at last **throw it off at the wheel side** of the machine, ready to be tied up in sheaves.

Watch and explain all this step by step.

4. **The twine-binding reaper** *will have even more interest for the children where it is used.*

This machine not only cuts the corn, but before casting it aside, **gathers it into a bundle, ties it round with twine,** and **delivers it as a bound-up sheaf,** laying the sheaves in regular **equal distances apart,** as it moves along.

Compare all this with the way in which the corn was formerly reaped, showing if possible one of the **old reaping-hooks** *or* **sickles.**

III. DRYING

1. *Take the children into another field now, where the cutting is all over, and the men are busy piling the sheaves in* **shocks** *or* **pooks.**

A dozen sheaves are stood up on end, **six on either side,** with their heads leaning towards each other, so that those on one side hold up those on the opposite side. **The pile of sheaves** so formed is **called a shock or a pook.**

2. *Compare these with the hay-cocks at haymaking time.*

Why is the hay piled in cocks? Because the farmer wants it to dry.

Why is the corn stood in pooks or shocks? Because **the corn must dry too** before it can be carried away. **The straw dries quickly when it is stacked in this way.**

IV. CARRYING

1. *If the visit has been well timed, the corn in some of the fields will no doubt be fit to carry. Take the children to watch this part of the work next.*

Call attention to the great lumbering waggons, **with their harvest-frames front and back,** *moving slowly along between the shocks of corn.*

2. At each shock they halt, while the men, one on either side, **lift the sheaves with their long forks** to the loader, who packs them in the waggon.

What an immense load the waggons are able to carry with the help of the **raids or harvest-frames.** When the last sheaf is handed up, and **it is all bound securely** with ropes, away they set off for the farm-yard at a slow rumbling pace.

V. STACKING THE CORN

The children already understand **the nature of the rick,** *and the object of stacking the corn. They should of course be taken now* **to see the work of rick-making,** *and on the way the teacher should endeavour to elicit from them all they can tell of the rick-yard.*

Arrived there, they will see going on before their eyes all that the teacher taught them in their earlier lesson.

SUMMARY OF THE LESSON

1. The farmer cuts his corn with a reaping machine. It used to be cut with a sickle.
2. Some reaping machines not only cut the corn, but tie it up in sheaves.
3. A dozen sheaves are piled up on end together to form a shock or pook.
4. The corn stands in shocks to dry.
5. When it is dry enough, the corn is carted to the rick-yard and stacked in a rick.

Lesson XXXIII

AUTUMN—(TIME ABOUT THE MIDDLE OF OCTOBER)

I. THE CROPS ARE GATHERED IN

1. THE ROOT HARVEST.—*Commence by reminding the children that their fathers are now busy in their spare time digging in the gardens and allotments, and so lead them to tell*

that this is the time for **digging up and storing potatoes,**[1] *before the very cold weather comes on.*

They must be stored in some place, where the winter frost cannot get at them, for **the potato cannot stand frost.**

Elicit too that the farmer is busy at this time getting in and storing his **swedes,**[2] **mangels,** *and* **other roots** *for feeding the sheep and cattle in the winter.* These, *like the potatoes,* must be kept secure from the frost.

2. THE FRUIT HARVEST.—*This thought of gathering in the crops will naturally lead up to the similar work now going on in the orchards.*

All through the summer there has been abundance of fruit, one kind following another, plums and damsons coming last of all. Now it is the **apple-gathering time.** Apples are the best of all our fruits, for they can be stored up and kept during the winter, when there is nothing else in the way of fruit.

Compare the apple with the soft juicy fruits of summer. None of these will keep very long. Why?

The apple, on the other hand, is a **hard dry fruit.** *It can be easily stored.* **Apples are the last of all the fruits to be gathered in.**

II. THE LEAVES BEGIN TO FALL

1. *Take the children for a ramble. They miss now the wealth of flowers, which met them at every turn during the summer rambles. The* **gardens** *already* **begin to look bare, ragged,** *and* **desolate,** *for nearly all the flowers are faded and gone, and the banks, hedgerows, meadows, and woods are very much the same. We do not now find the ground carpeted with wild flowers, as it was in the summer.*

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[1] Pass over for the present the fact that the potato is not really a root. This will be dealt with later on.

[2] Swedes and turnips are sometimes dug up and fed on the ground, but mangels are always stored for winter use.

2. *Call attention to the leaves on the trees.*

Most of them are **no longer green.** They are changing colour; they are **yellow, brown, purple, red**—almost every colour but green. Many, too, have fallen, and some fall as we pass along.

There is quite **a thick carpet of these fallen leaves** under the trees.

Tell that the leaves of trees always change colour and fall at this season of the year. We call this **the autumn.** *Call attention to the beauty of these* **autumn tints.** When the leaves are all fallen, the trees will have the bare look which they had in the winter-time.

Everything around us **prepares for winter** during this season of Autumn.

3. *The children should be encouraged to take home a collection of these fallen leaves. They may be* **easily pressed,** *and* **gummed in a scrap-book,** *and* **named for future reference.**

III. Nuts and Wild Fruits

1. *The children have scarcely been able, during their ramble, to resist the temptation of picking the ripe blackberries, which hang in such profusion on all sides.*

Let this now lead up to the next step in the teaching.

Point out that, although the flowers are nearly all gone, and the leaves are falling fast, there is plenty of brightness and beauty in the woods yet.

Instead of a wealth of flowers, we have now **a wealth of bright berries and other fruits.**[1] They are the fruits of these wood plants. We will find a few of them as we walk.

2. *It would be impossible to mention more than a few here,*

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[1] N.B.—There is one most important matter that should not be lost sight of by the teacher. Many of these berries and fruits are poisonous. The teacher must carefully impress this upon the children, pointing out those of his locality that are poisonous, and at the same time warning the children not to eat any but those they know well.

but the teacher will add to the list. Among the commonest are:—

THE WOODBINE, OR COMMON HONEYSUCKLE.—Small, round, glossy berries, changing from green to yellow, orange, and red as they ripen.

THE SLOE.—A glossy black fruit like a tiny plum —very sour—the fruit of the blackthorn, whose beautiful white blossoms we saw in the spring.

THE BLACKBERRY.—The fruit of the common bramble, whose white blossoms were so thick in every hedge in July.

3. *Call attention to the form of the blackberry. Lead the children to compare it with one of the summer fruits, which they have already examined—the raspberry.*

Like the raspberry, the blackberry is badly named. It is **not a berry at all.** It is a cluster of tiny stone fruits. There is **a seed case in the middle of each little fruit in the cluster.**

Compare it with the real berry of the woodbine to show the distinction.

4. THE "HIPS" AND "HAWS."—These bright red showy fruits are the chief support of the hard-pressed birds during the winter.

Why are they bright red? They are easily seen by the hungry birds.

The "hips" are the fruit of the wild rose; the "haws" the fruit of the beautiful hawthorn (red and white may).

5. THE WILD CRAB APPLE.—To be met with in every hedge. We saw its beautiful **white and rosy blossoms** in May.

6. *Before returning home set the children to collect* **acorns, hazel-nuts, beech-mast,** *and some of the* **winged seeds** *—such as those of the* **elm, maple,** *and* **sycamore.** *Show them how to distinguish one from the other.*

All these are the fruits of the plants from which they have fallen.

7. Look at this acorn. What would happen to it if I buried it in the soil? It would spring up and **grow into a young oak tree.**

Then, what must the acorn be? It must be **the seed, as well as the fruit** of the tree, because it is only seeds that grow.

Cut the acorn open, and show that it is so. **The inside kernel is the seed.**

Now proceed to open each of the other fruits which have been gathered, and show that in every case the seed is in the fruit. Compare this with the pips of an apple and a pear, and the stone of a plum and a cherry. **Autumn is the fruit-time of the year.** The seed is in the fruit.

SUMMARY OF THE LESSON

1. Autumn is the time to gather in the crops.
2. The leaves change colour and fall.
3. The flowers one by one die away.
4. There are nuts and wild fruits in the woods and hedges.
5 The fruit of a plant contains the seeds.

Recapitulate in class with the help of Brown's picture of "**Autumn Wild Fruits and Nuts.**"

SOME USEFUL MINERALS

Lesson XXXIV

A PIECE OF CLAY

Articles required for illustration: a lump of newly-dug common clay, and pieces of stone, sand, gravel, and chalk, specimens of Kaolin and other clays, a basin of water, a knife, a hammer, the clay balls, cubes, and bricks made during some former lesson, a piece of dough, a flower-pot, a lump of sun-dried clay.

I. INTRODUCTION

1. *PRODUCE one of the lumps of newly-dug clay, and proceed as follows:—*

Who can tell me what this is? It is a piece of clay.

Where did it come from? It was **dug out of the ground.**

Lead the children to name other things, besides clay, which they have seen dug up out of the ground, such as **stone, sand, gravel, chalk,** *as the case may be.*

Show specimens of each.

2. *Lead the children to compare these with the living, growing things which are also got out of the ground.*

Those things we call plants. Are clay, chalk, sand, and gravel plants too?

Break off some pieces from each of them, and lead the children to tell that these things have **no distinct parts** *as plants have—that* **one piece is exactly the same as another.**

3. What would happen to a plant if we cut it up in pieces like this? The plant would die.

Why don't these pieces of chalk, clay, and stone die? They are **not living things.**

Deduce further that as they are not living things, **they do not require to take in food from the soil to make them grow**—*that* **they do not grow** *in the ground as plants do.*

Explain that clay, chalk, sand, and gravel, and all things of this kind which we get out of the ground, are called **minerals.**

Clay then is a mineral. Let us see what we can learn about it.

II. MOIST CLAY

1. BROWN COLOUR.—Look at the clay as it lies on the table. Your eyes will tell you something as to its colour. It is of a **greyish-brown colour.**

If possible have specimens of other clay at hand, and show that all clay is not this colour—some kinds are **blue-black** *or* **slate colour,** *some* **yellow,** *some* **reddish-brown,** *and so on.*

Show the specimen of **Cornish clay** *(Kaolin). Tell that this is the* **purest form of clay,** *and it is* **white.**

Explain that the rougher kinds of clay, such as those on the table, get their colours from other things which lie near them in the ground.

2. HEAVY.—*Let one of the children now take the piece of clay in his hand.*

What is the first thing you find out by handling it? The clay is **heavy.**

How could you prove that it is heavy? By putting it into the water.

Let him do so, and point out that the clay sinks to the bottom of the water.

What does this tell us? It tells us that the clay is heavy; **it sinks because it is heavy.**

3. FEELS SMOOTH.—*Set him next to take the clay out of the water, and rub his hand over it.*

What do you notice about the clay now? It **feels smooth and moist.**

4. SOFT.—*Instruct him to take the clay in both hands and squeeze it; and then let him do the same with the stone. Elicit as before.*

Clay is soft. We can squeeze clay in our hands; **we cannot squeeze the hard stone.**

Do you remember any other way of finding out whether a thing is soft or hard? We can find out **by cutting it.**

Give him a knife and ask him to try to cut off a piece of the clay.

Clay is soft. It can be **easily cut** with a knife.

5. TOUGH.—*Illustrate further the softness of the clay by kneading, rolling, folding, and twisting the lump on the tray.*

Drop it on the floor, and beat it with a hammer, and point out that the clay changes its shape, but **does not break.** *Treat a piece of chalk in the same way.*

Clay is tough as well as soft; it **does not easily break.** Chalk is brittle; it breaks easily.

6. PLASTIC.—*Hand some pieces of the clay round the class now, and instruct the children to knead them up on their slates, as the teacher has already done.*

Let one of them work his piece up into a **ball**; *let another make a* **cube** *of his piece; set a third to make his piece into the form of a* **brick,** *and so on.*

Produce the similarly-shaped dried pieces made at some former lesson, and tell that these were shaped when they were soft, like those now in the hands of the children.

They have **kept the shape that was then given them**; those which have just been made would do the same, if we left them to get dry and hard. The **moist, soft clay** is said to be **plastic,** because we can **mould it into any shape** we please.

Show a piece of dough, or make some with a little flour and water, and repeat the experiments with that. Work it up into the shape of a biscuit, and compare it with an actual biscuit.

Dough like clay is plastic. Why?

The experiments may be further repeated with a piece of **soft wax** *or some* **putty.**

These things are plastic. Why?

7. NOT POROUS.—*Shape one of the pieces of clay into the form of a basin, and fill it with water. Point out that* **the clay holds the water—none of it runs away.**

What will happen if I pour water on the garden-mould in these flower-pots? The water will run away through the hole in the bottom of the pot.

Why? Because **the mould is porous**; the water soaks through the pores.

The clay, you see, on the contrary, **holds the water,** so that none of it runs away.

What do we learn from this? We learn that **the clay is not porous.**

III. DRY CLAY

1. *Produce the lump of dry clay now. Let the children take it in their hands and examine it. They will find that—*

(*a*) *They cannot squeeze it in their hands, as they did the moist clay.* **Dry clay is hard.**

(*b*) *It does not feel smooth to the touch.* **Dry clay is rough and cracked on the outside.**

Elicit from this that it is the water in the moist clay that makes it soft and smooth to the touch. **The dry clay has no water left in it.**

2. *Scrape the dry clay with a knife, and show that* **it crumbles to pieces** *readily. Drop a piece of it, or strike it with a hammer.* **It breaks easily.**

Treat the moist clay in the same way.

Does the moist clay break? No.

Why not? Because moist clay is tough and plastic.

Then what shall we say about the dry clay? **Dry clay is brittle.**

3. *Now place the dry clay on a slate, and let water trickle on it slowly, a few drops at a time, calling upon the children to observe what happens.*

Where is the water? It has disappeared. It is not on the slate, for the slate is dry. **The dry clay has sucked it up.**

Let fall some more drops, and show that the same thing happens.

The water is in the clay. **The clay has sucked it up.**

How can we say this in another way? We can say that **dry clay absorbs water.**

Then what else can you tell me about this dry clay? **Dry clay** must be **porous.**

Look at this piece of dry clay, and tell me whether you can see the pores or holes in it. No.

Is it porous then? Yes, it must be porous **because it sucks up water.**

4. *Illustrate its greediness for water by letting one of the children put the piece of dry clay to his tongue, and explain what happens.*

The clay sticks to the tongue; it robs the tongue of all the moisture it can get, and is greedily sucking to get more.

Our piece of dry clay on the table will absorb a large quantity of water. It will suck up water till all its pores are quite full; **but after that it will not take another drop.**

Put a piece of the dry clay in water, and after leaving it there for a few minutes take it out, and show that it is no longer hard and brittle; it can now be kneaded up.

It has sucked up water; **the water has made it soft, tough, and plastic once more.**

SUMMARY OF THE LESSON

1. Clay is a mineral, because it is dug out of the earth.
2. Clay is heavy, soft, tough, plastic, and not porous.
3. When clay is dry it becomes hard, brittle, porous.
4. Dry clay will absorb water till its pores are full; but after that it will not take in any more.

Lesson XXXV

CLAY—ITS USES

The teacher will require: a lump of moist clay, a small pair of hand-tongs, a can of water, one or two tumblers, a hammer, specimens of red ballast, two new bricks (one of which should be put into water at the commencement of the lesson), a pair of scales, some sifted ashes from the fire-grate, the sun-dried brick that was moulded in class on some previous occasion, specimens of Kaolin, a piece of common drain-pipe, a flower-pot, and a few earthenware and china articles.

A pencil box, from which the lid and bottom have been removed, could be extemporised to serve the purpose of a mould for making a brick.

I. Introduction

1. *Soon after the commencement of school roll a piece of clay into a ball, and put it into the middle of a bright red fire. Call the attention of the children to what is being done, and tell them that during the morning we are going to have another lesson about clay. We want to find out first of all what will happen to the clay in the fire. We will leave it where it is till we want it.*

2. *When the time for the lesson comes round, take the clay out of the fire with the tongs, place it on a slate in front of the class, and let the children examine it. As far as their eyes can tell them, they will notice that the fire seems to have had no effect on it. It is* **not altered in shape or size.**

Elicit that **some things would have burnt away** *in the fire; but the clay has not burnt away—it is all there just as when we put it in.*

3. *Show a similar piece that has been kept in the fire for a long time, and left to cool. Explain what has been done to it, and tell that, as the one we have just taken out of the fire is too hot to handle, we will examine this instead.*

Hand it round the class, and the children will see at once that it is now **as hard as a stone.**

The clay has been **baked** in the fire. The fire has made it hard like this.

II. Properties of Baked Clay

1. *Put a piece of baked clay into a tumbler, fill it up to the brim with water, and then call upon the children to observe*

what takes place. They will see the water gradually sink in the glass.

The water has not flowed over the top of the glass. What has become of it?

Lead the children to find out for themselves that it must have **soaked into the clay.**

Would water soak into this piece of moist clay? No; **moist clay is not porous.**

Then what shall we say about this baked clay? It must be **porous. It absorbs** or **sucks up the water into its pores.**

2. Here is a piece of dry clay. What would happen to it if I put it into the water? It would become **soft and plastic** again.

Then let us take the ball of baked clay out of the water, and see whether that is plastic too.

Let the children handle it, and try to squeeze and press it into a different shape. They find that **the baked clay is too hard** *for them to squeeze;* **it is not plastic.** *Explain that* **it can never be made plastic again.**

3. *Strike it a smart blow with a hammer, and show that it is* **brittle; it breaks into pieces with the blow.**

Baked clay, like dry clay, is **porous**—it absorbs water. But the water **cannot make it plastic again—it is a hard, brittle substance.**

III. Uses of Baked Clay

Red Ballast.—

Show the specimen, and tell what it is called.

Put a piece of it in water, and strike it with the hammer, as we did the clay, to prove that it is **a hard, brittle,** *and* **porous substance.**

Tell that this is nothing but clay, **which has been burned or baked** *in great heaps in the open air.*

The **baking has changed the moist clay** into this hard, brittle, porous substance.

It is very useful for making hard dry roads. Why?

BRICKS.—

1. *Take the brick out of the water now. Place it in one of the scale-pans of a pair of scales, and a dry new brick in the other. In the absence of scales let one of the children balance the bricks in his hands.*

Why should this one be so much heavier than that? **It has sucked up water.** It is the water that makes it weigh heavier.

What can you tell me about the brick then? It is **porous.**

2. How does the bricklayer make his bricks fit in when he is building? He breaks off pieces of them with his trowel.

What do we learn from that? We learn that **bricks are brittle,** or they would not break.

Show in this way that bricks are the same kind of **hard, brittle, porous things,** *as the* **red ballast** *we have just examined.* **Bricks too are made of clay.**

3. *Mix some clay and ashes together into a stiff paste with water, and when it is as soft and smooth as putty, press it into the mould, which should be stood on a small drawing-board, and wetted inside to prevent the clay from sticking to it. The top may be smoothed off with an old knife or a ruler, and when the mould is lifted, the brick itself will be left on the board.*

Tell that in the brick-fields, where tons of the material are prepared at a time, the mixing is all done in a mill.

4. *Show a brick which was made at some previous lesson, and has since been dried in the sun. Tell all about it, and proceed:—*

This brick, which we made in the class a long while ago, is now dry and hard. Would bricks of this sort do for building?

The children will have no difficulty in telling that **this brick is nothing but dry clay**; *that as* **dry clay is porous** *it would* **suck up the rain**; *and that the water would make the clay* **soft and plastic** *again.* **A house built with such bricks would fall to pieces.**

5. *This will lead to a brief description of the* **brick-kiln.**

The bricks after being well dried in the sun are **piled up in great stacks**, and **burned or baked** for a week and sometimes a fortnight.

It is the baking that **changes the nature of the material**, and makes the bricks suitable for building purposes.

EARTHENWARE.—

Tell that **tiles, chimney-pots, drain-pipes,** *and* **flower-pots** *are also made of common clay; and that our* **plates** *and* **dishes, basins** *and* **jugs,** *and the* **china cups** *and* **saucers** *and* **ornaments** *are made of clay too, but of a purer, whiter kind.*

China, or porcelain as it is called, is made of the **purest** and **whitest clay** that is to be found.

Show the specimen of **Kaolin** *or* **China clay.**

As clay of all sorts is a kind of earth, we give the one common name **earthenware** to all things made from it.

SUMMARY OF THE LESSON

1. Clay does not burn away in the fire. It bakes hard like stone.

2. Moist clay is soft, tough, and plastic. It is not porous; it will not absorb water.

3. Dry clay is hard, brittle, and not plastic. It absorbs water because it is porous. The water would make it plastic again.

4. Baked clay is hard, brittle, and porous. It will absorb water, but it can never be made plastic again.

5. Ballast, bricks, tiles, flower-pots, drain-pipes, and all kinds of earthenware are made of baked clay.

Lesson XXXVI

A PIECE OF CHALK

The teacher will require two lumps of rough chalk. One of these should be weighed, and then placed in the middle of a bright, red fire as early as possible in the morning. If it is taken out just before the commencement of the lesson, it will be cool enough to handle when it is wanted. This of course must be done in the presence of the class. Set it aside out of sight for the present.

I. INTRODUCTION

Show the piece of rough, unburnt chalk, and proceed at once to elicit from the children that this is another mineral substance, making them give their reasons, of course, for saying so.—**It is not made up of a number of different parts**—*one piece is exactly the same as another. Chip off some pieces, and show that it is so.* **It is dug out of the ground,** *but* **it does not live and grow in the ground as plants do.**

If there are any "Downs" in the neighbourhood of the school, the children will be familiar enough with chalk. Explain that those great hills, hundreds of feet high, are all chalk. In other districts it must suffice to mention that there are such hills in some parts of the country.

We are now going to see what we can learn about this mineral—chalk.

II. PROPERTIES

The children will find no difficulty of course as regards its colour. Their eyes will tell them that it is **white.** *We use the* **white chalk** *for writing on the* **blackboard.**

Compare it with a piece of newly-dug clay. Elicit that it is **harder than clay**; *that it is not moist like the clay, but* **dry**; *and that it is* **brittle** *and* **breaks easily,** *while clay is tough.*

Drop the two things on the floor, or strike them with a hammer, and show that it is so.

Rub the chalk on the blackboard. It makes a mark **because some little pieces break off** *as we rub it. Try the same thing with a piece of stone.*

Put a piece of the chalk in a tumbler of water, and stir it up.

The chalk, you see, breaks up in the water, and **turns the water white like milk.** We will now stand the tumbler aside for the present. We shall want to look at it by and by.

III. Chalk and Lime

1. *Turn now to the other piece which has been in the fire. It is cool enough to handle by this time. Lead the children in the first place to tell that the chalk, like clay,* **does not burn away** *in the fire. It looks to be exactly the same in shape and size as when we put it into the fire.*

Look at it again, side by side with the other piece of chalk on the table. Do you notice any difference in its colour? It is **not white now,** like the other chalk. It has turned **a dirty yellowish white.**

2. *Let the children take it in their hands, and try to break it.*

It breaks much more easily than chalk, and it gives a **crackling sound** as it breaks. It crumbles up easily in the fingers; and yet it is not so soft as the chalk, for **it will not make a mark on the blackboard.**

3. *Place it in the scales now and weigh it.*

It weighs less than it did when it was put into the fire. It has lost something in the fire.

The heat of the fire has changed the chalk. It is no longer chalk. We call it **lime.**

4. *Put a piece of the lime into a tumbler of water, and observe that* **it makes a hissing sound** *as soon as it touches the*

water. Stir the water and stand it aside. In a very short time **the whole of the lime will disappear,** *leaving the water itself quite clear.*

Produce the other tumbler now in which we put the chalk.

When we stood this aside, the chalk had made the water white like milk. It is no longer white; **it is quite clear now.**

What has become of the chalk?

Call attention to the chalk lying in a wet layer at the bottom of the glass.

We can pour off this water, and leave all the chalk behind. But we could not do this with the other tumbler. **The lime has disappeared in the water.** It is all there although we cannot see it. We could not pour away this water **without pouring away the lime with it.**

We say the **lime dissolves in the water;** and we call this water **lime-water.**

Do the same with some sugar and salt. All these things dissolve. We say they are soluble. **Lime is soluble; chalk is not soluble.**

5. *Break off another piece of the lime, put it in a saucer, and let some water trickle on it slowly, calling upon the children to observe what happens.*

a. The water disappears the moment it falls. **The lime seems to suck it up.**

b. Presently a **cloud of steam** begins to pour out from the lime, and **the lump begins to crack.**

c. If we put our hand on the saucer, **we find it has become very hot.**

d. The lime at last falls away into **a dry powder.** The lump has broken up; and **there is no water to be seen.** It has all disappeared.

6. *Tell that this lime, which is thirsty for water, and sucks it up so quickly, is called* **quick-lime.** When chalk is heated in the fire, **it changes to quick-lime.**

Call attention now to the white dry powder in the saucer.

Pour some more water on this, and observe that there is no longer any hissing sound, no longer any cloud of steam rising from it.

The lime is not thirsty for water now; it has had enough; **its thirst is slaked.** We now call it **slaked lime.**

Notice that it lies in the saucer, a wet, sticky, muddy substance.

7. *Tell (and let the children see for themselves later on) that if it is left for a while, it will* **set hard like stone.**

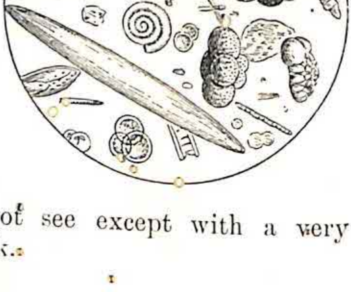
Lead the children to tell from this that the bricklayer makes his **mortar** *with lime. It sticks fast to the bricks, and when it sets hard,* **it holds the bricks together.** *He uses quick-lime for this purpose.*

Mix the rest of the quick-lime with some sand, and pour water on the mixture. This is the way he makes his mortar.

IV. What Chalk is

Turn once more to the tumbler, with the wet layer of chalk lying at the bottom.

Tell that if a tiny piece of this wet chalk mud, no bigger than a pin's head, were pressed out flat and then dried, it would form a white powder; that if a little of this powder were then put under a strong glass, to make it look larger, we should be able to see that it is made up of **immense numbers of shells.**



Long long ago each of these was **the shell of a little living creature.** The tiny animals themselves died, but their shells were left behind. These tiny shells, which we cannot see except with a very strong glass, have made chalk.

Show a picture of the magnified shells. Each one was once the home of a little creature.

Immense numbers of them could stand on a sixpence. Think that all those great hills of chalk are made of nothing but these shells.

Promise the children that some day they shall hear more of this.

SUMMARY OF THE LESSON

1. Chalk is a white, soft, brittle mineral.

2. It does not burn away in the fire. It changes into lime.

3. This lime sucks up water very quickly. It is called quick-lime.

4. Water changes quick-lime into slaked lime.

5. Lime dissolves in water; chalk does not dissolve.

6. Chalk is made up of immense numbers of tiny shells in which little animals once lived.

Lesson XXXVII

A LUMP OF COAL

Provide the following articles for illustration: a lump of common coal, and specimens of fossil coal, a piece of wrought-iron, a hammer, a bowl of water, the spirit lamp, pieces of stone, chalk, clay, and slate, a carrot, turnip, and potato, a long clay tobacco-pipe filled beforehand with powdered coal, and stopped with clay. Brown's picture, "Forest of the Coal Period," should be shown.

I. ITS PROPERTIES

1. *SHOW the lump of common coal. Let the children tell what they can about its uses, and lead them to discover for themselves the properties of the substance in some such way as follows:—*

Let us begin by looking at it. What does it look like? It is **black and shiny.** It looks like a lump of **smooth, polished, black stone.**

Call one of the children to the front, and let him take it up and handle it. Lead him to tell that it is a **hard, heavy substance.**

You say this lump of coal is heavy. But if I were to give you a very small piece to handle, could you learn from that whether coal is heavy or light?

Drop a very small piece of coal into water, and point out that it at once sinks to the bottom. **Light things float; heavy things sink. Coal is heavy.**

2. This piece of iron is also a hard substance. Now take the hammer and strike the iron and the coal a smart blow, and tell me what you observe. The **coal breaks easily,** but the iron does not break.

What do we say about things that break easily? We say they are **brittle.** Coal then is a **hard, brittle substance.**

3. *Let the children examine the coal closely and they will discover that it is* **made up of flat layers.**

Instruct the boy at the table to strike one of the pieces **lengthwise,** *and show that the coal breaks up easily,* **because the layers split asunder** *with the blow. Show that it is not so easy to break the coal* **by striking it crosswise,** *for then the layers do not separate or split.*

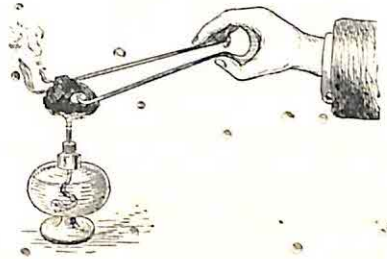
4. *Now call attention to the boy's hands.*

The blackness of the coal comes off and makes our hands dirty when we touch it.

5. *Hold a piece of coal in the flame of the spirit lamp with the small hand-tongs, and let the class notice and tell exactly what takes place.*

First a **puff of thick smoke** oozes out from the coal, then the coal itself **swells up into a soft mass,** and then it **bursts into a bright flame.** Soon the whole lump will be in a blaze. If it were then left to burn, the blaze would gradually die down, and the lump would get **red-hot** and **throw out great heat.** After a time the whole of the coal would be **consumed** or **burned away**, and nothing would be left but some **white ashes**.

6. We learn from this that coal is **very inflammable**, that it burns until it is all consumed, and that **it gives out great heat** while burning.



In connection with this show and compare the burning of wood, charcoal, peat, and coke.

These things all burn so well that they are **used as fuel** for making our fires, for cooking our food, and warming our houses. But coal is the best of all.

II. What Coal is

1. *Compare the lump of coal with stone, chalk, clay, and slate on the one hand, and with a carrot, a turnip, and a potato on the other.*

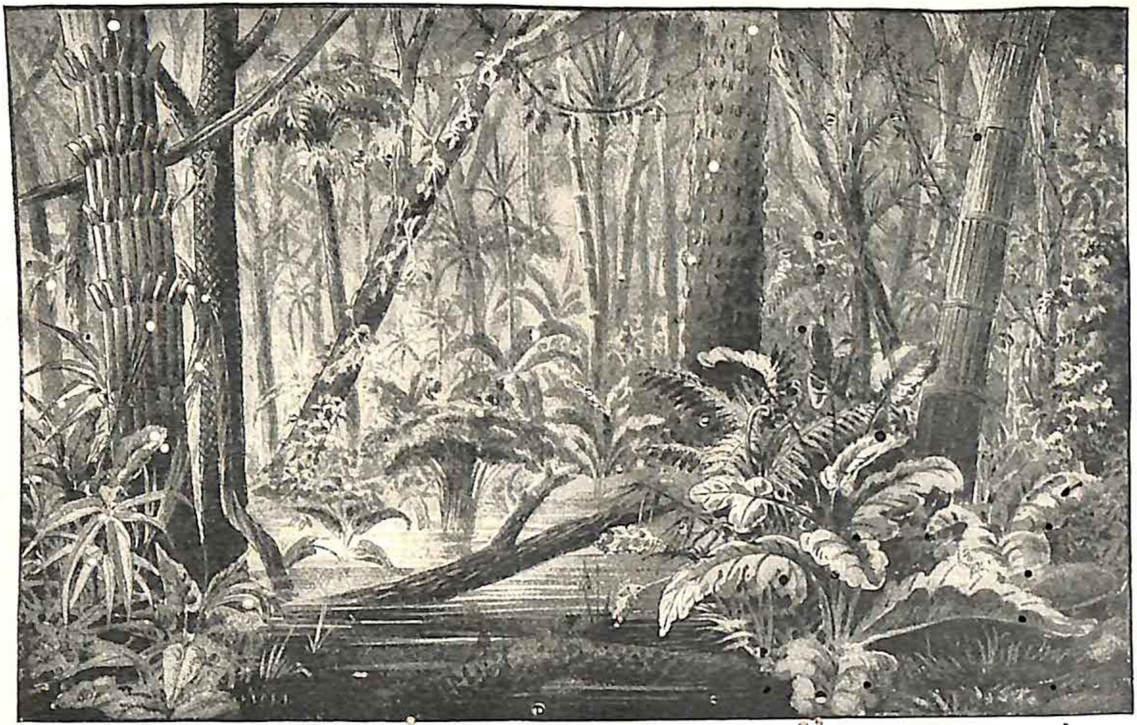
Which of these things is the coal most like—the stone or the carrot? It is **more like the stone** than the carrot.

What kind of things are the carrot and the turnip? They are the roots of plants; they grow in the ground.

What name do we give to the stone, chalk, and other things of that sort? We call them minerals.

Where do all minerals come from? They are dug out of the ground.

You are quite right in saying that coal is more like a mineral than a plant. It is **all in one piece**; it has **no**



FOREST OF THE COAL PERIOD.

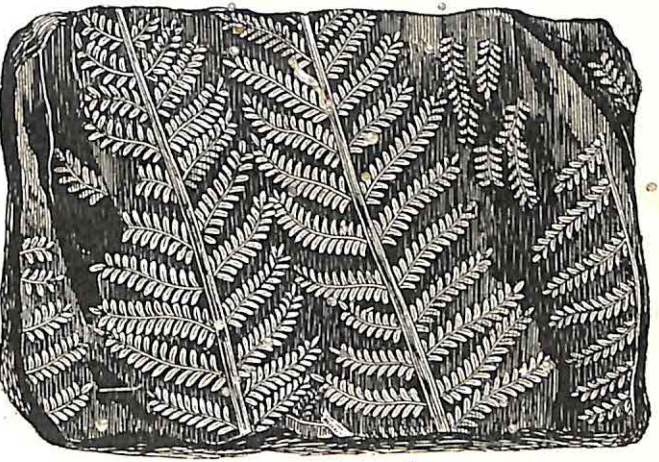
separate parts; one piece is just like another. Like stone and all other minerals, too, **it is dug out of the ground.**

Coal is so much like these minerals that **we often call it a mineral.**

Yet, strange to say, **it is not a mineral** in the same sense as clay, stone, or slate.

2. *Explain that* **coal was not always in the ground,** *as the other minerals have been.* It **was made** *in a wonderful way* **from trees and plants,** *that grew many thousands of years ago.*

Tell that some of the forests that grew on the earth in those days sank down and got buried deep in the ground, where they have been hidden away ever since.



FOSSIL COAL.

During all this time **they have been changing** *from wood and leaves, roots and branches,* **into a new kind of mineral substance,** *which we dig up and call* **coal.**

3. I cannot make little children like you understand how this wonderful change took place; but we know

what must have happened, because pieces of coal are often dug up with the **impression of the leaves and ferns marked upon them**, and other pieces are sometimes met with **showing the shape of the stems, branches, and bark** of those old plants.

We can thus even form a good idea of the kind of trees and other plants that grew in the forests of those distant days.

Show the picture of the forest, and an actual specimen of **fossil coal** *if possible.*

III. Coal-Gas

1. *Take a long clay tobacco-pipe; fill the bowl with powdered coal, and cover up the top perfectly close with clay.*

N.B.—*To ensure success with the experiment it is best to do this preparation-work beforehand, as the moist clay is almost sure to crack with the heat, and that would interfere with the working. If it were done the day previous to the lesson, the clay would be quite dry before it was wanted. The teacher would of course show, and explain with another pipe, what had been done.*

We are going to put the bowl of the pipe into the fire, and I want you to watch the other end of it, and see if you can find out what happens.

In a little while some **light-coloured smoke** *is seen coming out from the stem of the pipe*

2. *Hold the back of a plate against the cloud of smoke, and show that some of it settles on the plate, forming* **a sticky black coating there, with the smell of tar.**

Apply a lighted match to the smoke as it issues from the pipe. **The smoke takes fire and burns** *with a dirty, smoky flame.*

3. *Blow out the flame, and ask the children to watch till they see the bowl of the pipe get red-hot.*

Can you see any smoke coming out now? No.

I will prove to you that, although you can see nothing, yet there is really something coming out of the pipe.

Apply the lighted match as before. *A* **bright yellow flame,** *quite distinct from the smoky one,* **now bursts forth.** There is something **coming out of the pipe** which is inflammable, and that something **has been made from the coal burning in the bowl.**

If we blow out the flame we shall not see anything, but the lighted match will soon prove to us again that the same substance is still pouring out from the pipe.

4. *Explain that this substance, which we have been making from the coal in the pipe, is called* **gas.** The proper name is coal-gas.

That black sticky stuff on the plate, which smells like tar, **is really tar—coal-tar.** It always comes off from the coal when gas is being made.

5. *It is needless to point out that, in the vast majority of villages throughout the country, gas is altogether unknown. The teacher must be content therefore to tell the children that, in the large towns, the street lamps and the shops and houses are lighted up with this coal-gas at night.*

The people in the towns burn this gas just as we burn oil in our lamps to give us light at night.

Take the pipe out of the fire now and let it cool; and when it is cool, break the bowl and show its contents.

What is this? It is all that is left of the coal when the gas and tar are taken away. We call it **coke.**

SUMMARY OF THE LESSON

1. Coal is a black, shiny, hard, brittle substance.
2. It burns easily and throws out great heat; we use it for fuel.
3. Coal is dug out of the earth; it was formed from trees and other plants which once grew in the ground. It is not a mineral.
4. Gas is made from coal. Its proper name is coal-gas.
5. Tar and coke also come from coal.

Lesson XXXVIII

METALS

Articles for illustration: specimens of all the common metals with one side rough, the other polished; some pieces of sand-paper; two dinner-knives (one very rusty); specimens of other metals in a state of rust; a strong pocket-knife; specimens of the metallic ores.

I. Introduction

1. *Show some pieces of lead and tin. Ask the children to name any articles they may have seen which are made of these things.*

Tell that lead and tin, like clay, chalk, and coal, are got out of the ground. Point out that they have no different parts, such as plants have—that one piece is exactly the same as another. Elicit that they must be **minerals.**

Explain that gold, silver, copper, iron, and zinc are minerals of the same kind as lead and tin.

These things are all dug out of the ground. They are all alike in many ways, and **unlike other minerals**; so we put them into a class by themselves, and call them by the same name—**metals.**

2. *Throw the piece of lead into the middle of a bright red fire, and call upon the children to observe what happens to it.*

The lead **does not bake hard** as a piece of clay would, **nor does it burn away** like coal. **It melts with the heat,** and falls through in liquid drops, into the ash-pit below.

Do the same with a piece of tin. Tin also melts in the fire.

Tell that **all the metals**—*gold, silver, copper, iron, lead, tin, and zinc*—**melt with heat.** *It is that which makes them* **different from other minerals,** *such as clay, chalk, or stone.*

II. THE LUSTRE OF METALS

1. *Show a sovereign and a bright new shilling, and elicit that one is made of* **gold,** *the other of* **silver.** *Lead the children to name other articles made of gold and silver, such as watches, chains, rings, brooches, lockets, bracelets, pencil-cases, etc.*

Show the polished specimens of the other metals—iron, lead, tin, copper, and zinc. Elicit the names of these, assisting of course when necessary, and after laying them, with the sovereign and the shilling, side by side on the table, proceed as follows:—

Now look at all these things, and try to find out one point in which they are all alike.

What is the first thing you notice? **They all shine.**

2. *Hand the specimens to the children and instruct them to rub each one with a piece of sand-paper.*

What do you observe now? **The more they are rubbed, the brighter they shine.**

Tell that we may describe the **bright, shining surface** *of these things as their* **lustre.**

We say they have **a bright lustre**; they are **lustrous.**

Compare them with pieces of stone, chalk, and clay. These have no lustre.

In speaking of their bright, shining surface it is usual to call it a **metallic lustre**—it is **the lustre of these metals.**

III. METALS RUST

1. Here are two dinner-knives. One you see is bright: it has the metallic lustre; but what do you notice about the other? **It has no lustre:** it is **rusty.**

Now observe what takes place when I rub the rusty knife with this sand-paper. I rub off all that **reddish-brown rust,** and we see the **bright lustre of the metal beneath.**

Elicit that the metal of which the knife is made is **steel,** *and that steel is* **a kind of iron.** *Show some badly rusted articles made of iron and steel. Tell that these metals soon rust* **if they are left in a damp place.**

Point out that the rust has actually "eaten into" the metals —it would in time **eat them away completely.**

All articles made of **iron and steel must be kept in a dry place** if we wish to prevent them from rusting.

2. *Now show pieces of copper, lead, tin, and zinc, some bright and some rusted. Point out that the rusted ones are* **dull**; *they have* **lost their lustre.** *We say they are* **tarnished**; *and they all soon tarnish when exposed to the air. Show, however, that a rub with the sand-paper will quickly bring back the lustre.*

Notice too the difference between **the tarnishing** *of these things and* **the rusting of iron and steel.** *The rust* **does not eat into copper, tin, zinc, and lead,** *and destroy the metals, as quickly as it does iron and steel.*

Tin and zinc rust least of all; the **rust of lead** forms a **thin coating over the metal,** and when this is once formed, it **protects it from any further action** of either damp or air.

3. Now look at the sovereign and the shilling on the table. One is made of gold, the other of silver. Did you ever see any gold or silver article in a state of rust? No.

Tell that **gold and silver do not rust**—*that* **silver tarnishes** *and becomes dull, but* **gold is always bright.**

We call gold and silver **precious metals**; the rest—iron, copper, lead, tin, and zinc—are known as **the common metals.**

IV. THE METALS COMPARED

1. COLOUR.—*Lead the children to distinguish the colours of the various metals.*

Gold is **yellow, copper red. Silver** and **tin** are **white metals,** but if both are held up to the light, it is easy to distinguish **a bluish tint** in the **silver,** and **a yellowish tint** in the **tin.**

Iron and steel, lead and zinc, are **grey metals.**

2. WEIGHT.—The next property of the metals you can learn only by taking them in your hands. I will pass these specimens of iron, copper, lead, tin, and zinc round the class for you to examine.

What do you notice? They are all **heavy.**

Now look at them. They are all the same size; but are they all the same weight? No.

Which is the heaviest? **Lead.**

Which is the lightest? **Zinc.**

Tell that **gold** *is* **the heaviest** *of all the metals we have examined, and next in order after gold come* **lead, silver, copper, iron, tin,** *and* **zinc**—*zinc being the lightest of all. Let the children compare the weight of the sovereign and the shilling.*

N.B.—*Platinum is purposely omitted from consideration for the present.*

3. HARDNESS.—*Hand round some pieces of iron, copper, lead, tin, and zinc—not the polished specimens, but rough pieces kept for the purpose, and set the children to try to cut them with a knife.*

Which cuts the easiest? The **lead.**

One of them you cannot cut at all. Which is that? The **iron.**

You can cut the copper, tin, and zinc, but not so easily as you cut lead.

Now what do we learn from this? We learn that **metals differ in hardness. Iron is a very hard metal, lead a very soft metal.**

V. METALS MELT WITH HEAT

1. *Proceed next to heat pieces of lead and tin in separate spoons side by side over the lamp flame. Let the children watch till the lead is seen to flow about in a liquid state, and then point out that* **the tin in the other spoon shows no signs of melting.**

Why is this? The heat that melts lead is **not enough to melt tin.**

What must we do to melt the tin? We must **make it hotter.**

Very well then; I will put the spoon, with the pieces of tin in it, into the hottest part of the fire. Watch what happens now.

Point out that it must be much hotter in the fire than in the flame of the lamp, for the spoon itself is beginning to get red-hot.

When the spoon is red-hot the tin begins to melt; but not till then.

Deduce that it **requires more heat to melt tin than to melt lead.**

2. What is this red-hot spoon made of? It is made of **iron.**

I have something else in the fire which is **red-hot,** and that too is made of iron. Let us take it out and look at it.

Take the poker out of the fire and contrive while doing so to **bend it out of shape.** *Call attention to it now, and elicit that the heat of the fire must have* **made the iron soft.** *We cannot bend the poker when it is cold.*

Tell that if iron is put into a very, very hot fire, many times hotter than this, it will not only get soft like the poker, **but will actually melt into a liquid,** *like the lead and the tin, and* **flow about as they did** *when they were melted.*

Deduce from this that the heat of our fire, which is able to melt tin, **is not enough to melt iron,** *but will make it* **red-hot and soft.**

All metals melt, although some require more heat than others.

VI. Ores and Smelting

1. *Remind the children that all the metals are minerals, and come out of the ground. Point out that clay, chalk, slate, stone, and marble are dug out of the ground too. We find them in the ground* **all ready for our use.**

Now show specimens of the **metallic ores,** *side by side with the metals themselves.*

Let the children observe that there is no likeness at all between these **lumps of rough-looking stone** *and the metals which they contain.*

We call them **iron-ore, lead-ore, copper-ore,** and so on. Each one contains metal of some sort, but it is **mixed up with earth, stone,** and many other things, and would be **quite useless** in this form.

2. What would happen if these ores were put into a very hot furnace? The **metal** in them **would melt.**

Which is the heavier—the metal or the stone and other things mixed up with them? The **metal.**

What would become of this heavy metal, as it melted into a liquid in the furnace? It would **sink to the bottom** and run through, as a piece of lead would if we threw it into this fire.

3. *Tell that this is exactly what is done with these metallic ores.* They are put into intensely hot furnaces; **the heat melts the metal** in them, and this, because it is heavy, **flows away,** and **separates from the other parts of the ore.** This is called **smelting the ore.**

Then, when the liquid metal cools, **it becomes solid** once more, and is ready to be turned into account for useful purposes.

Promise to tell more about this in a later lesson.

SUMMARY OF THE LESSON

1. Metals are minerals which have a bright lustre.

2. Most metals lose their lustre and become tarnished and rusty if they are left in the damp.

3. Silver and gold do not rust. We call them the precious metals.

4. Metals differ in colour, weight, and hardness.

5. All metals melt when heated, but some require more heat than others.

6. Most metals are found mixed with earth, stone, and other things. In this state we call them ores.

7. The pure metal is obtained by smelting the ore in very hot furnaces.

Lesson XXXIX

A COAL MINE (AN INFORMATION LESSON).

Brown's picture of the mine should be shown.

I. COAL-SEAMS

1. *COMMENCE by eliciting from the children briefly all they can tell of the nature of coal. It was formed from the remains of forests that once grew on the earth. These forests became buried underground, and there they have been* **changed into a new sort of mineral matter.** *The new substance is dug out of the ground, and is called* **coal.**

Remind the children, in the next place, that we dig other substances out of the earth as well as coal. Explain that, if we could dig a very deep hole in the ground, we should not find coal and these other minerals all mixed up together.

Most of the minerals are found in **layers or beds** lying one upon the other. It would be impossible to get at any of them without digging through the beds above them.

2. Coal, like the other minerals, lies buried in the earth in beds or layers, and these beds stretch for many miles underground. We call them **seams of coal;** and the places where coal-seams are met with are known as **coal-fields.**

Explain that in some coal-fields there are several beds of coal, one below the other, but they are always separated by beds of clay, sandstone, or other rocks. Hence some of the coal-seams lie very deep in the ground; some are much nearer the surface.

Point out too that there is usually a bed of clay under the *coal-seam.* **This was the soil in which the coal plants once grew.**

The coal-seams are not all the same thickness. Some are only **a few inches thick,** others are **twenty or thirty feet through.**

II. MAKING THE MINE

Explain that when men want to dig for coal, the first thing is to find out whether there are any coal-seams in the ground. They cannot see the coal, for it is buried deep in the earth. How can they tell?

1. BORING FOR COAL.—They bore a hole in the ground with long sharp steel chisels worked by machinery. As the hole is bored it is lined with tubing, and so the chisel goes down through one bed after another.

From time to time it is pulled up, and another tool, called **a wimble,** is pushed down the tube. When this tool is brought up, **it brings with it some of the materials** through which the chisel has been cutting its way, and so the men find out whether there is coal there or not.

2. SINKING THE SHAFT.—*Tell that the great hole in the ground where the coal is dug up is called* **a coal-mine**; *the men who dig the mine are* **miners.**

When the boring tells that there is coal in the ground, the miners set to work to dig a great "**pit**" or "**well,**" straight down into the earth. This is called **the coal-pit,** or **the shaft,** and is from ten to fifteen feet across. *Show by measurement.*

The sides of the pit are lined with brick-work, iron, or timber, as the digging goes on. Why?

Explain that this is **to keep the sides from falling in,** *and also* **to prevent the water in the ground from soaking through** *into the shaft.*

Picture the men digging down through sandstone, clay, and other rocks, until at last they come to the coal-seam.

Tell that some shafts are as much as **eighteen hundred feet deep**; *very few are less than two hundred feet. Compare these figures with the height of the church steeple or some other familiar object.*

Lead the children next to think of the clay, sand, and other things which are dug up out of the great pit, as the work goes on. What becomes of all this?

Tell that, as the pit gets deeper and deeper, the men are let down to their work in **cages** *or* **baskets**, *by great engines; and that the clay and other rocks which they dig out are raised to the surface in the same way.*

III. In the Mine

1. *The best way to interest the children in the mine itself will be to take them in imagination down the pit, and picture to them the scene step by step.*

Describe the pit's mouth, with its **mountains of coal close by.** This coal has all been dug out of the mine.

Lead the way to the shed, and call attention to the **great engine.** *Tell that the engine is at work night and day* **pumping** *out from the mine the water that soaks into it from the earth on all sides.*

Notice the strong steel rope which passes round the great wheel of the engine. This rope lowers the **cage,** or **basket,** or **coal-waggon** down the shaft, and brings it up again from the bottom.

Not only is the coal brought up in this way, but **the miners go down to their work and return again in these cages.** Let us go down with them.

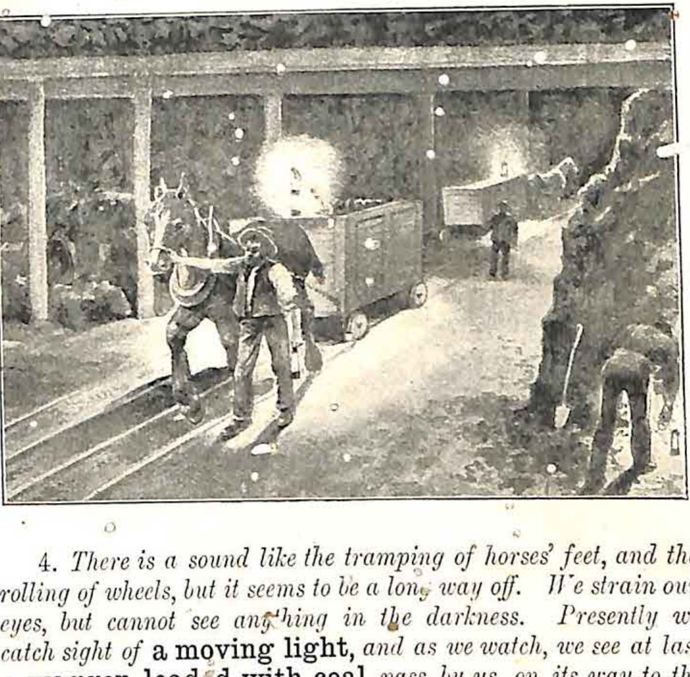
2. *Picture teacher and children in the cage, holding on fast, as it rushes swiftly down the hole—black darkness all around, and far above them the mouth of the pit, which seems to get smaller and smaller every moment.*

At last the noisy rush is over, the bottom is reached, and all step out, but they are now hundreds of feet down in the earth.

3. The first thing to strike us would be **an immense**

fire blazing brightly at the bottom of the shaft. Then as our eyes got used to the darkness we should see **long rows of lights** stretching away in front of us. Let us follow these lights and find out where they will lead us. One of the men will show us the way, and we shall each of us want a lamp, for it is **darker than the darkest night.**

As we walk along we find we are in **a sort of tunnel,** or **underground road,** with a lamp here and there on both sides of us. The roads are from **twelve to fourteen feet wide,** and run for miles.



4. *There is a sound like the tramping of horses' feet, and the rolling of wheels, but it seems to be a long way off. We strain our eyes, but cannot see anything in the darkness. Presently we catch sight of* **a moving light,** *and as we watch, we see at last* **a waggon loaded with coal** *pass by us, on its way to the bottom of the pit ; and soon after* **some empty waggons** *on their return to the distant parts of the mine to be re-loaded, roll by in the opposite direction.*

They roll along very easily, for **they run on tramway lines** which are laid down in the road.

5. *Think of the horses that draw these waggons.* **Pit-ponies** *they are called. Tell that they never come up above ground again, when once they are taken down into the mine. The stables in which they live are* **dug out in the sides of the road.**

But look closely at the floor, sides, and roof of this underground road, and you will find that **it is all coal.** The road itself **is cut through one of the coal seams.**

Explain that, when the miners have dug the shaft straight down as far as the coal-seam, instead of digging farther down, they begin at once to cut away with pick-axe and shovel all the coal out of the seam. Wherever they dig **they follow the seam,** *and so* **all the stuff they dig out** *in making these roads* **is coal.**

6. From these main roads, smaller ones are dug out, crossing and recrossing each other at right angles. They are the **roads, streets, lanes,** and **alleys** of the underground town.

Promise to tell more about the mine in another lesson.

SUMMARY OF THE LESSON

1. Coal is found in beds or layers deep down in the earth.
2. The layers are called seams of coal.
3. The coal-pit is called the shaft. It is like a great deep well.
4. The men who work in the mine are called miners.
5. They go down in cages or baskets.
6. There are roads, streets, and lanes cut out in the coal.
7. Horses and waggons run along these underground roads.

Lesson XL

THE MINE AND ITS WORKERS (INFORMATION LESSON)

Show the picture used in the last lesson, calling attention to details of shaft, cage, waggons, lamp, etc.

I. MINERS AT WORK

1. *LEAD the children, by means of a few carefully chosen questions, to tell all they can of the mine, and its underground roads and streets, and then proceed on the imaginary visit, as follows:—*

We have not yet thought about the miners themselves. We saw the men on the coal-waggons as they passed along the tramway-road, but it was too dark for us to notice what they were like. Suppose we get into one of these empty trucks now, and go to the distant part of the mine where the miners are at work.

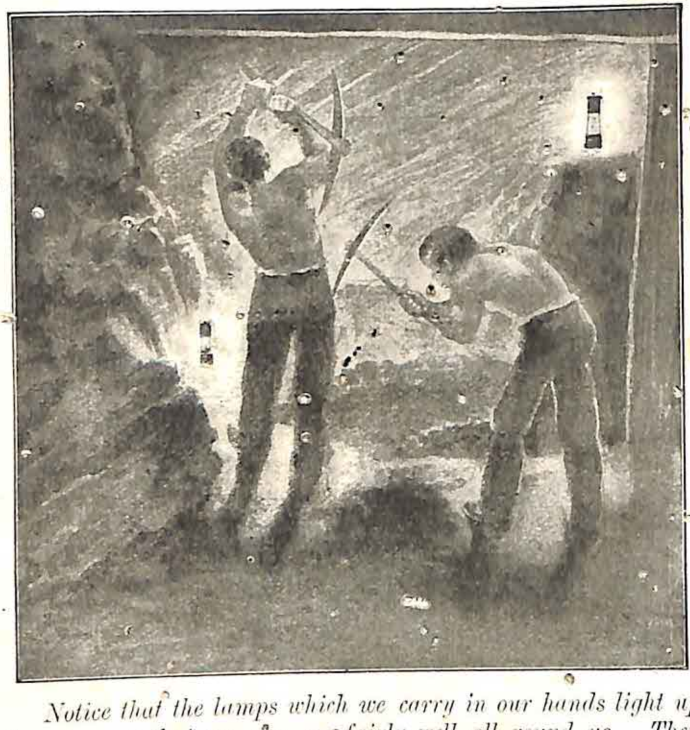
2. *Remind the children that our tramway ride along this dark road, with its dim lights here and there, will most likely be a long one, for the places where the miners are actually at work digging out the coal* **may be a mile or more from the shaft.** *Tell that these places are known as* **the workings or the stalls.**

To reach the workings we must get out of the waggon, and leave the main road at last **for one of the side streets.** As we grope our way along with our lamps in our hands, we presently **hear the sound of the pick-axe and shovel,** and a little later on we find ourselves in the midst of the men and their work.

3. *Picture the scene. The* **half-naked men,** *with faces, arms, neck, and body* **black with the grime of the coal dust**—*all at work* **hewing out the coal** *with the pick, or*

shovelling away *what has been cut out. Some of them are even* **lying on their backs,** *and hewing away at the coal above their heads.*

How hot and close the air is. *See how the sweat rolls off these poor fellows as they work, and trickles down their skin in dirty streaks.*



Notice that the lamps which we carry in our hands light up the place, so that we can see fairly well all round us. Then call attention to **the one little lamp** *fixed up on the side of the wall.* This dim light is all that the miner has to work by.

4. When the **hewer** has cut away a heap of coal, it is put into a truck, and pushed along the narrow passages

by boys called **putters.** The **putters** take it in this way to one of the main roads. Here a number of trucks are chained together, and drawn by horses along the tramway to the bottom of the shaft.

In some mines there are **several hundred men** and from **fifty to sixty horses** always at work.

As the truck-loads of coal are brought to the bottom of the shaft **they are loaded on cages,** and drawn up to the surface of the earth by the steam engine, just as we came down.

5. *Notice that as the men work they are careful not to cut away all the coal,* **or the roofs of their roads and passages would fall in upon them,** *and crush them to death. They therefore leave* **great blocks or pillars** *to support the earth above and prevent it from falling in.*

When the seam has been well worked, and nearly all the coal removed, the miners proceed to cut away the great blocks or pillars of coal, which were at first left standing to support the roofs. **They always begin with the blocks farthest from the shaft.**

While they are at work cutting away these blocks, **they prop up the roof** with great beams of timber. Then as soon as all the coal in the block is removed, the timbers are taken away, and **the roof, having no support, falls in.**

Why do they always begin with the blocks farthest away from the shaft?

II. DANGERS OF THE MINE

Remind the children in the next place of the little experiment with the tobacco-pipe, and lead them to tell all about it. We **made gas from the coal; the gas took fire and burned.**

Explain that down in the mine a strong-smelling gas something like the gas we made is always escaping from the coal. The miners call it **fire-damp.**

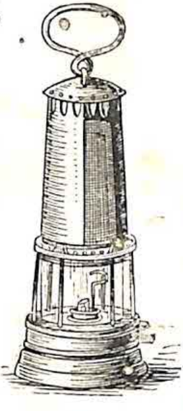
As it passes off from the coal, it mixes of course with the air in the mine, and it is then **terribly dangerous,**

for the moment a flame comes near it, this gas explodes.

Point out that it is all pitchy darkness in the mine, and that the miners cannot work in the dark. **They must have a light of some kind.** *If they had a candle, or an ordinary lamp, the flame would catch the fire-damp, and an awful explosion would take place.*

III. The Davy Lamp

Tell that every man who goes down into the mine is provided with a lamp, in which **the light is surrounded with wire gauze,** *so that the bad gas and the flame cannot come together.*



Show a picture of the safety-lamp, or better still, a lamp itself, if possible.

Illustrate the principle of its action by holding a piece of wire gauze over the flame of a candle. **The flame does not pass through the gauze.** *If there is gas in the mine, some of it will pass through the gauze, into the lamp, and burn there round the flame, but* **the flame itself cannot pass outside the wire gauze,** *and so the gas in the mine cannot take fire.*

Every lamp is locked before it is taken down, and so all is quite safe. But sometimes one of the men disobeys orders and opens his lamp, perhaps to light his pipe, although he knows that smoking is forbidden. If this is done, only for a moment, it is quite enough to cause a most terrible explosion, and perhaps all in the mine are killed.

IV. Fresh Air in the Mine

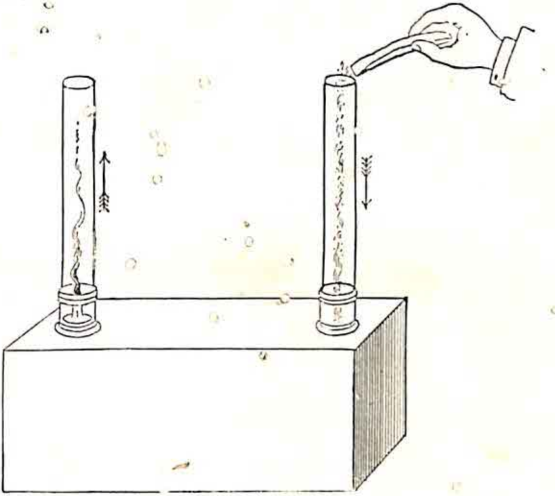
1. We have seen how the miners prevent the bad gases from taking fire and exploding. But don't you think it would be better if they could get rid of the bad gas altogether from the mine?

What do I do when our room becomes close and stuffy and filled with bad air? I open the doors and windows **to drive out the bad air,** and **let fresh air into the room.**

This is just what has to be done in the mine. Let us see how they do it.

2. *A very simple little contrivance will make the whole thing quite clear to the children. A small wooden box and a couple of lamp-glasses will be all that is wanted.*

Such a box could be easily obtained from the shop in the village. A baking-powder or blacking box would do admirably.



Have the lid removed, and cut a couple of round holes in the bottom, near the ends, exactly the size to receive the two lamp-glasses. Fit the glasses into the holes, and place a lighted candle under one of them.

3. *As the candle burns, hold a piece of burnt paper, or some other very light substance, over the top of this glass, and at the same time let one of the children hold a piece of smouldering rag over the top of the other.*

Two things will now be clearly seen. The smoke from the smouldering rag **will be drawn down the one glass,** *and the light substance held over the top of the other* **will be carried upwards.**

Why is the smoke passing down this glass?

Why are the little bits of burnt paper flying up from the other?

It is the air which is moving, and it makes these other things move.

4. We must find out why the air is moving.

Elicit that the flame of the candle must make the air inside the glass hot and light—**much lighter than the air of the room**—*and then the rest will be easily deduced.*

The air inside the box itself, as well as the air in the room, is heavy, and **this heavy air is pressing against the light air in the glass,** and forcing it up.

All the time the candle is burning in one glass, air from the room is constantly rushing down the other **to push the light air upwards.**

5. In the mines the bad gases are removed and fresh air is supplied in a manner something like this.

The mine has **two shafts** at some distance from each other. At the bottom of one shaft **a large fire is always kept burning.** This is the fire we saw when we reached the bottom of the shaft.

The fire makes the air very hot, and **it rises and escapes** through the mouth of the shaft. Other air, however, must take its place, and so there is a rush of air along the underground passages and galleries towards the bottom of the shaft.

6. And where do you think this air comes from? It is **fresh air from above ground,** which passes down the second shaft.

This fresh air, as it rushes along, mixes with the bad gas in the passages, and by the time the mixture of air and gas reaches the bottom of the shaft where the fire is burning, it has lost its power of exploding. The heat from the fire then drives it up above the ground, and so the air of the mine is kept fresh.

SUMMARY OF THE LESSON

1. The road from the shaft to the workings is often a mile long.
2. The miners work there hewing out the coal nearly naked, for it is very hot and close.
3. A gas called fire-damp comes from the coal.
4. Fire-damp explodes in the mine if a flame comes near it.
5. The miners use a clever lamp called the Davy lamp, to give them light.

THE END

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